

# Westinghouse

Catalogue  
of  
Electrical  
Supplies  
1923 - 1924

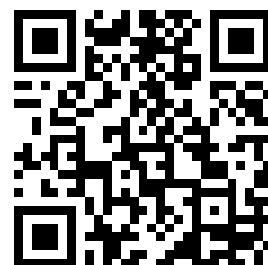


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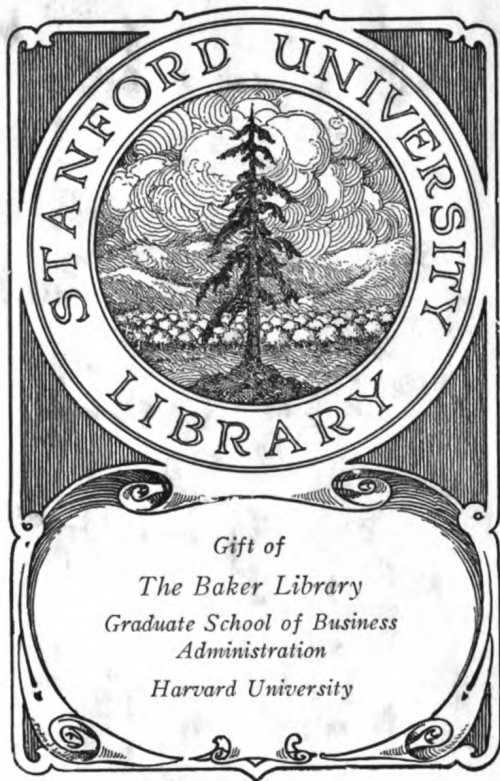
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# Westinghouse Representatives in the United States

LOCATION	WESTINGHOUSE SALES OFFICES	WESTINGHOUSE AGENT-JOBBER	WESTINGHOUSE WAREHOUSES	WESTINGHOUSE SERVICE REPAIR SHOPS
Alabama, Birmingham	2000 First Ave.	Moore-Handley Hardware Co.		
Arizona, Tucson	90 Church St.			
Arkansas, Little Rock	2311 State St.			
California, Bakersfield	2224 San Emedio St.			
Fresno	J and Mariposa Sts.			
Los Angeles	420 San Pedro St.	Illinois Electric Co.	420 San Pedro St.	420 San Pedro St.
San Francisco	1 Montgomery St.	Fobes Supply Co.		525 Mission St.
Colorado, Denver	910 Fifteenth St.	Mine & Smelter Supply Co.	1909 Blake St.	1909 Blake St.
Connecticut, Bridgeport	Bruce & Seymour Sts.		Bruce & Seymour Sts.	Bruce & Seymour Sts.
Hartford	220 Market St.			220 Market St.
New Haven	152 Temple St.	Hessel & Hoppen Co.		
D. C., Washington	723 Fifteenth St. N. W.	H. C. Roberts Elec. Supply Co.		
Florida, Jacksonville	East Union & Ionia Sts.	Pierce Electric Co.	East Union & Ionia Sts.	
Tampa		Pierce Electric Co.		
Georgia, Atlanta	426 Marietta St.	Gilham-Schoen Elec. Co.	426 Marietta St.	426 Marietta St.
Hawaii, Honolulu	Hawaiian Elec. Co. Ltd.			
Illinois, Chicago	111 W. Washington St.	Illinois Electric Co.	3550 S. Morgan St.	32 S. Peoria St.
Springfield	130 S. Sixth St.			
Indiana, Evansville		Varney Elec. Supply Co.		
Fort Wayne	3143 Broadway			
Hammond	P. O. Box 238			
Indianapolis	Westinghouse Bldg.	Varney Elec. Supply Co.	814-820 Senate Ave.	814-820 Senate Ave.
Iowa, Burlington	315 North Third St.			
Cedar Rapids	1705 C Avenue, E.			
Des Moines	416 West Seventh St.			
Sioux City		The McGraw Co.		
Kansas, Wichita		United Electric Co.		
Kentucky, Louisville	312 Fourth Ave.	Tafel Electric Co.		
Middlesboro	P. O. Box 518			
Louisiana, New Orleans	921 Canal St.	Electric Supply Co.	1028 So. Rampart St.	
Maryland, Baltimore	121 E. Baltimore St.		121 E. Baltimore St.	501 E. Preston St.
Massachusetts, Boston	10 High St.		12 Farnsworth St.	12 Farnsworth St.
Springfield	82 Worthington St.			
Worcester	507 Main St.			
Michigan, Detroit	1535 Sixth St.	Commercial Elec. Supply Co.	1535 Sixth St.	1535 Sixth St.
Jackson	Peoples Nat'l Bank Bldg.			
Minnesota, Duluth	306 W. Superior St.			
Minneapolis	2303 Kennedy St. N. E.			2303 Kennedy St. N. E.
St. Paul		St. Paul Elec. Co.		
Missouri, Kansas City	1012 Baltimore Ave.	Satterlee Electric Co.	1214-16 W. Ninth St.	
St. Joseph		Columbian Electrical Co.		
St. Louis	717 S. Twelfth St.	The McGraw Co.	717 S. Twelfth St.	12th & Gratiot Sts.
Montana, Butte	52 East Broadway	Montana Electric Co.	Butte, Montana	
Nebraska, Omaha	1319 Farnam St.	The McGraw Co.		
New Jersey, Newark	40 Clinton St.			
New York, Albany	Journal Bldg.			
Brooklyn		McCarthy Bros. & Ford	150 Milton St.	160 Seventh St.
Buffalo	Ellicott Square			150 Milton St.
Elmira	338-342 Water St.			
New York	165 Broadway	Alpha Elec. Co. Inc.	Bush Term. Brooklyn	
Niagara Falls	205 Falls St.			
Rochester	119 E. Main St.	Rochester Elec. Supply Co.		
Syracuse	S. Warren & E. Wash. Sts.	H. C. Roberts Elec. Supply Co.		
Utica	110 Genesee St.			
North Carolina, Charlotte	200 S. Tyron St.	Carolina States Elec. Co.	E. 7th & North A. Sts.	
Raleigh	522 Fayetteville St.			
Ohio, Canton	Box 292			
Cincinnati	Third & Elm St.		Third & Elm Sts.	Third & Elm St.
Cleveland	Euclid & E. 14th Sts.	The Erner Electric Co.	Orange Ave. Term. Whse.	1255 West Fourth St.
Columbus	209 S. Third St.		181 S. Lazelle St.	
Dayton	14 W. Fourth St.			
Toledo	Madison & Superior Sts.			
Youngstown	Federal & Chestnut Sts.			
Oklahoma, Oklahoma City	Main & Broadway Sts.	United Electric Co.		
Tulsa	309 So. Galveston St.			
Oregon, Portland	Sixth & Oak Sts.	Fobes Supply Co.		
Penna, Johnstown				47 Messenger St.
Philadelphia	1325-1329 Chestnut St.	H. C. Roberts Elec. Sup. Co.	927-31 N. Front St.	214-220 N. 22nd St.
Pittsburgh	306 Fourth Ave.	Robbins Electric Co.	29th St. & Liberty Ave.	6905 Susquehanna St.
Scranton		Penn Elec. Engineering Co.		
Wilkes-Barre	W. Market & Franklin Sts.			
Tennessee, Chattanooga	701 Market St.			
Memphis	130 Madison St.	Riechman-Crosby Co.		
Texas, Dallas	Akard & Commerce Sts.		2107-9 Pacific Ave.	
El Paso	Oregon & Mills Sts.	Mine & Smelter Supply Co.	513 N. Ochoca St.	
Houston	Main & Congress Sts.	Tel. Electric Co.		
San Antonio	1105 Denver Blvd.			
Utah, Salt Lake City	Second South & Main Sts.	Intermountain Electric Co.	573 W. 2nd St. South	573 W. 2nd St. South
Virginia, Richmond	Seventh & Franklin Sts.	Tower-Binford Elec. & Mfg. Co.		
Washington, Seattle	3451 E. Marginal Way	Fobes Supply Co.	3451 E. Marginal Way	3451 E. Marginal Way
Spokane	Riverside & Stevens Sts.	Washington Elec. Supply Co.		
Tacoma	Rust Bldg.	Fobes Supply Co.		
West Va., Bluefield	Federal & Raleigh Sts.	Superior Supply Co.		
Charleston	Capitol & Virginia Sts.		Leroy Swinburne Bldg.	
Huntington	2nd Ave. & 9th St.	Banks Supply Co.	2nd Ave. & 9th St.	2nd Ave. & 9th St.



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# Westinghouse

*Catalogue of*  
**Electrical  
Supplies**

1923-1924



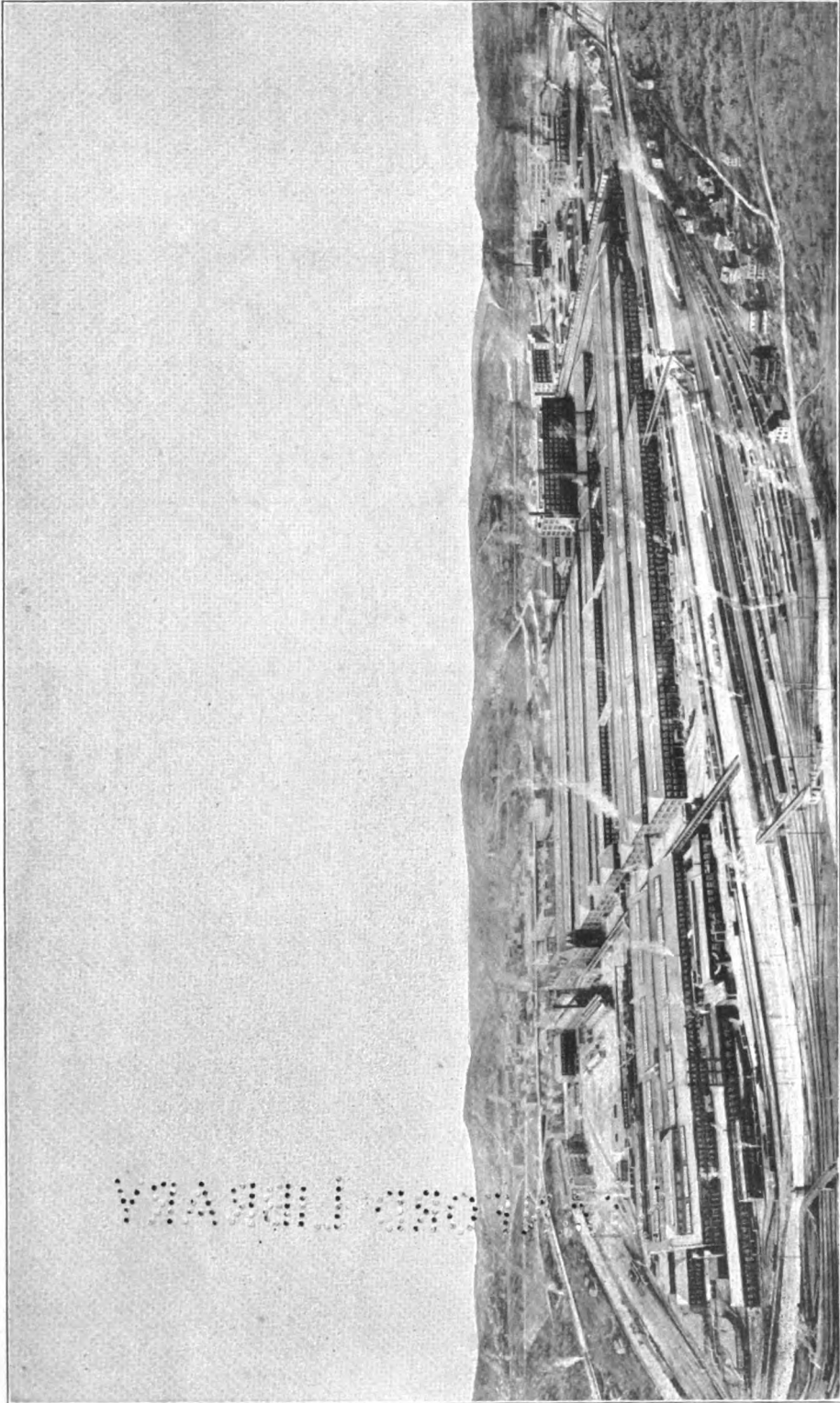
*Supersedes Westinghouse Catalogue of  
Electrical Supplies, 1921-1922*

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Westinghouse Electric & Manufacturing Company

East Pittsburgh, Pa.

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EAST PITTSBURGH WORKS,  
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY



# INTRODUCTION

**T**HE WESTINGHOUSE Catalogue of Electrical Supplies presents an almost complete list of apparatus manufactured by the Westinghouse Electric & Manufacturing Company or obtainable through its district offices and agent-jobbers. The information on electrical supplies is given in full. A general outline of the Company's industrial motors and controllers, railway supplies, power and marine machinery, radio apparatus and automotive equipment is also included; complete information on these will be furnished on request.

This catalogue replaces all catalogues issued heretofore on electrical supplies.

For the convenience of users of the catalogue a very complete cross-index is given in the pages following; this is printed on blue paper so that it can be quickly located. A style number index, also on blue paper, is located at the back of the book; this will be found convenient in checking invoices.

**Approximate Cost Multipliers**—Multipliers for convenience in estimating approximate costs are shown on page xviii. These multipliers, as well as the list prices throughout the catalogue, are included for convenience in estimating and are not offered as a quotation. While approximately correct at time of issue, they are subject to change without notice, and should not be used as a basis for ordering unless confirmed by quotation.

**Style Numbers**—To facilitate ordering and the classification of records, each piece of standard apparatus has a style number, which should be stated in ordering. Each style number designates a definite piece of apparatus as listed.

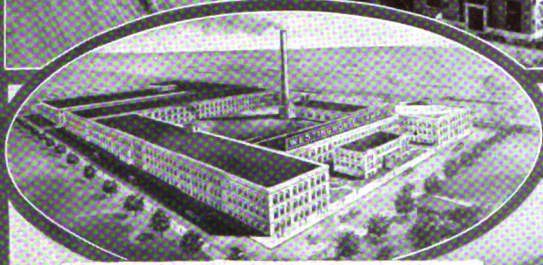
**Weights**—All weights given in this catalogue to enable the calculation of freight charges, are approximate.

**Dimensions**—All dimensions given in this catalogue are for reference only. For official dimensions, apply at the nearest district office of the Company.

*See Ordering Instructions on Page xvi*



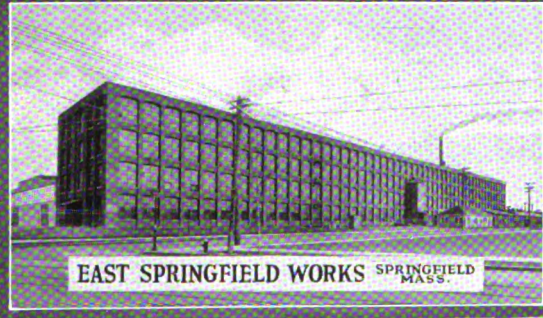
SOUTH PHILADELPHIA WORKS, LESTER PA.



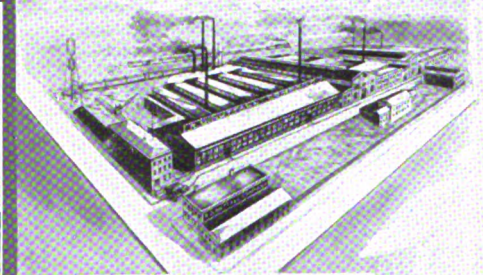
MILWAUKEE (WISC) WORKS, WESTINGHOUSE LAMP CO.



MIDDLETOWN (CONN) WORKS, WESTINGHOUSE LAMP CO.



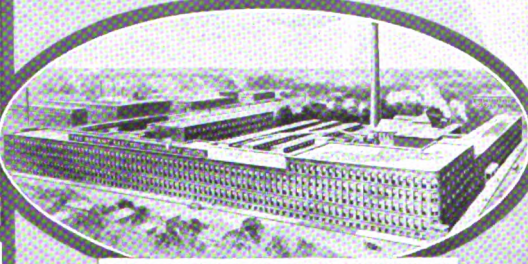
EAST SPRINGFIELD WORKS SPRINGFIELD MASS.



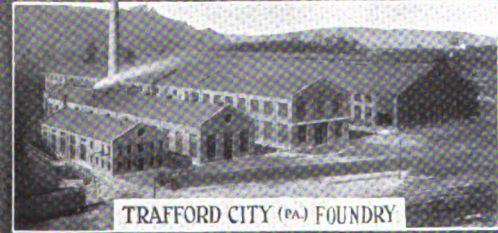
R.D. NUTTALL CO. PITTSBURGH, PA.



INDIANAPOLIS (IND) WORKS, WESTINGHOUSE LAMP CO.



THE BRYANT ELECTRIC CO., BRIDGEPORT, CONN.

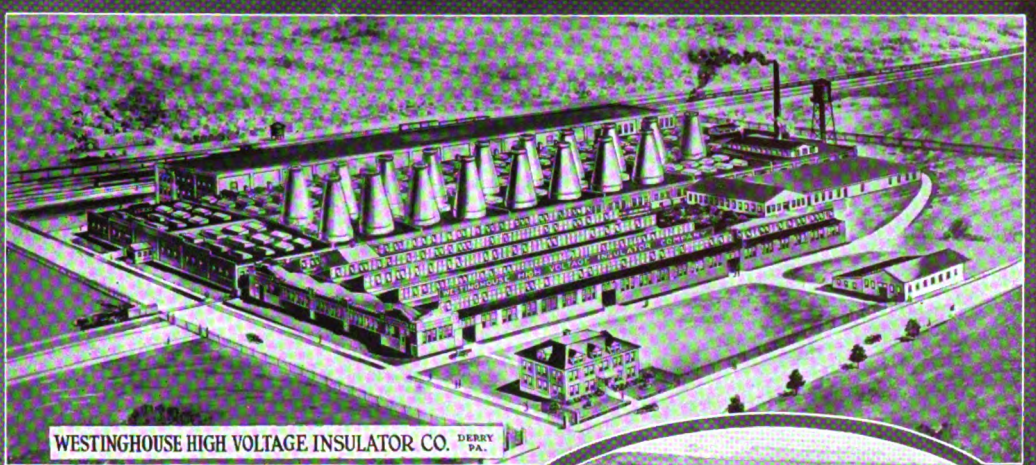


TRAFFORD CITY (PA) FOUNDRY

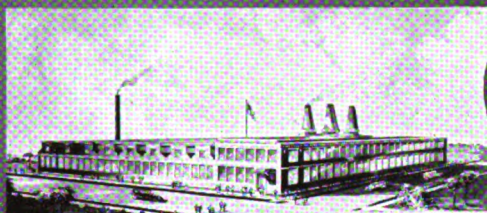


CLEVELAND (OH) FOUNDRY

# SOME OF THE WORKS OF THE WESTINGHOUSE



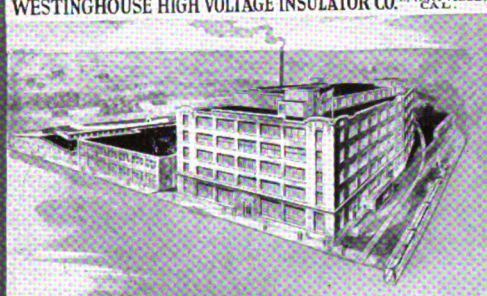
WESTINGHOUSE HIGH VOLTAGE INSULATOR CO. DERRY PA.



WESTINGHOUSE HIGH VOLTAGE INSULATOR CO. EMBURYVILLE PA.



BLOOMFIELD (N.J.) WORKS, WESTINGHOUSE IAMP CO.



WESTINGHOUSE ELECTRIC PRODUCTS CO. MANSFIELD O.



NEWARK WORKS, NEWARK, N.J.



TRENTON (N.J.) WORKS, WESTINGHOUSE IAMP CO.



PITTSBURGH METER CO. PITTSBURGH PA.



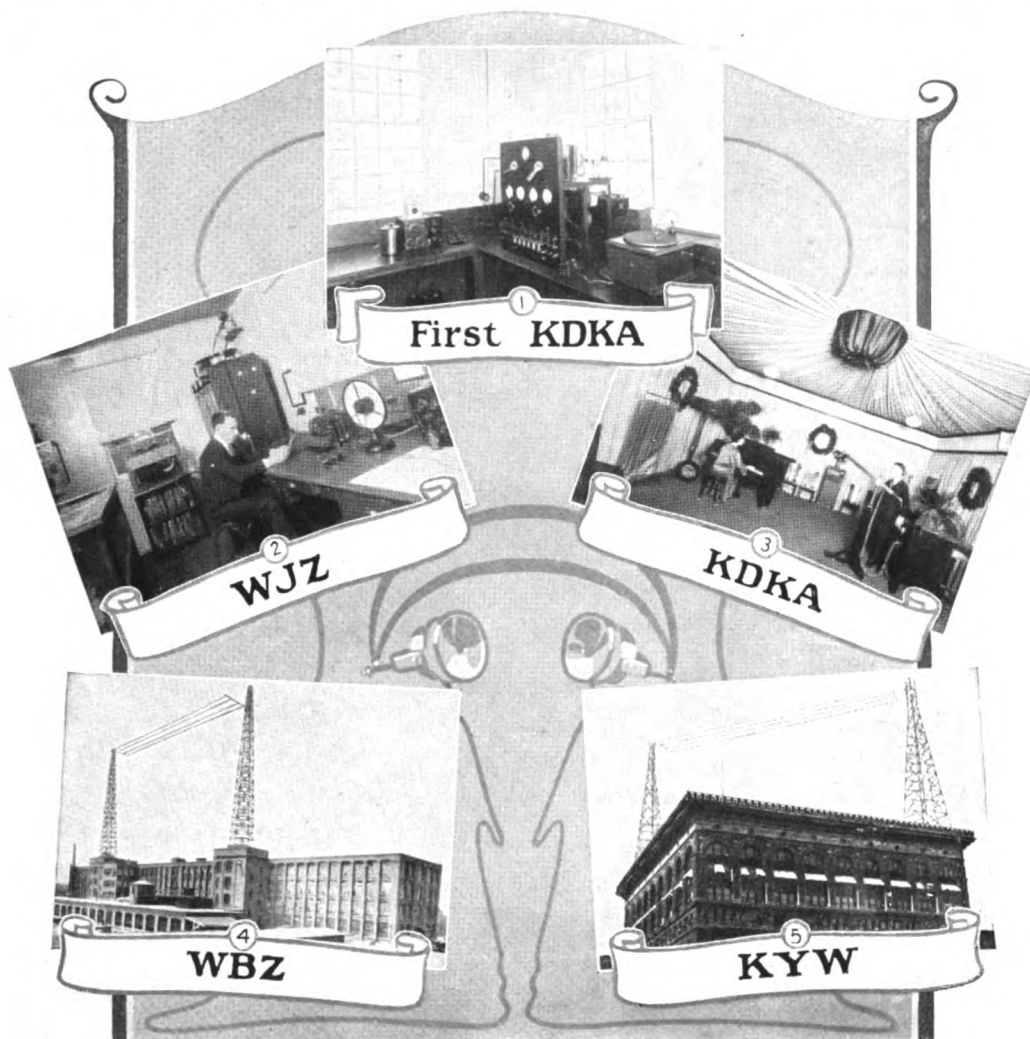
ATTICA WORKS. ATTICA NY.



GEO. CUTLER CO., SOUTH BEND IND.

# ELECTRIC & MFG. CO. AND ASSOCIATED COMPANIES

# Westinghouse The Pioneer of Radio Broadcasting



1.—First transmitting set used for Radio Broadcasting—Station KDKA, East Pittsburgh, Pa., as it appeared November 2, 1920.

2.—Station WJZ, Newark, New Jersey, famed as the International Broadcasting Station, the first American station to be heard in England and France.

3.—Present Broadcasting Studio of Station KDKA, East Pittsburgh, Pa.

4.—Station WBZ, Springfield, Mass., second Westinghouse radio station, opened September, 1921.

5.—Massive towers of Station KYW, the first broadcasting station in Chicago.

**R**ADIO broadcasting station KDKA, the first of its kind in the world, began broadcasting at East Pittsburgh on the night of November 2, 1920, and met with such success that the Westinghouse Electric & Manufacturing Company soon established other broadcasting stations at Springfield, Mass., Newark, N. J., and Chicago, Ill. The interest created by the pioneer station, KDKA, accounts, to a large extent, for the remarkable growth of radio broadcasting. From this single station, with 25,000 listeners in its early days, there has sprung up throughout the country within less than three years, more than 600 broadcasting stations with a combined audience of over three million.

## SOME IMPRESSIVE FACTS ABOUT WESTINGHOUSE ELECTRIC

**T**O ANYONE familiar with the history of electrical development, the name, Westinghouse Electric & Manufacturing Company, stands for achievement. It is the name not simply of a great manufacturing organization, but of a great institution, which has played and continues to play a part of first importance in the promotion of the world's progress.

To trace the history of the Westinghouse Electric & Manufacturing Company is to touch at the source of some of the most striking and far-reaching contributions that electricity has made to civilization.

Founded by George Westinghouse as The Westinghouse Electric Company in 1886 for the manufacture of electric lighting apparatus, it has grown and spread until today its influence is to be felt in every field of electrical endeavor and its products are numbered in the thousands.

To it belongs the credit for having placed electric lighting on a commercial basis, for having made possible the cheap and efficient long-distance transmission of power by the development of the alternating-current system and the induction motor; for having greatly assisted in the success of the steam turbine, by introducing it in this country and helping largely to bring it to its present state of perfection; for having produced and developed the turbine-generator.

To it also must go the credit for visioning the possibilities of the marine turbine with reduction gear and for having done a great part of the work in connection with the development and application of this idea; for having produced the apparatus which made possible the harnessing of Niagara Falls; for having given to the world the first induction watt-hour meter; for having helped largely to bring electric railroading to its position of commanding importance, for having established radio broadcasting, and for having done countless other acts and made countless other contributions affecting man's well-being through the application of mechanical and electrical science.

Wherever one may go in the civilized world, he is greeted by the name Westinghouse, for the ramifications of this great organization extend to the very farthest corners of the globe.

## **East Pittsburgh Works**

*(See frontispiece, page ii)*

An idea of the size and scope of this institution may be suggested by a few figures; those directly following apply to the East Pittsburgh Works:

Employs over 20,000 people.

Total floor space exceeds 100 acres.

Monthly payroll averages \$2,500,000.

Power house capacity, 28,000 horsepower.

Coal consumption, over 500 tons per day.

Monthly shipments approximate 1,000 carloads.

Uses 165 electric traveling cranes in capacities up to 100 tons.

To traverse the entire Works requires a walk of over twelve miles.

## **Other Westinghouse Plants**

*(See pages iv and v, preceding)*

In addition to the Works at East Pittsburgh the Company owns plants at the following points:

South Philadelphia, Pa., a plant covering 500 acres of ground along the Delaware River and employing 3,500 people, where steam turbines from  $\frac{1}{2}$  to 70,000 kilowatts capacity, condensers, marine propelling equipment and steam plant auxiliaries are made.

Newark, N. J., where watt-hour meters, instruments, relays, and fans are made. Employs 3,500 people.

East Springfield, Mass., manufacturing small motors, radio and automotive equipment. Employs 3,600 people.

Attica, N. Y., where over 90,000 square feet of floor space are devoted exclusively to the manufacture of stoking apparatus.

Cleveland, Ohio, and Trafford City, Pa., for making iron and steel castings used by the Company. Employ 2,000 people.

Mansfield, Ohio, works of the Westinghouse Electric Products Company, manufacturers of electric heating appliances, ranges, safety switches and safety motor-starters. Employs 1,200 people.

Derry, Pa., and Emeryville, Cal., works of the Westinghouse High Voltage Insulator Company, manufacturers of porcelain insulators. Employ 900 people.

South Bend, Ind., works of the George Cutter Company, manufacturers of industrial, commercial and street lighting equipment. Employs 500 people.

**SOME IMPRESSIVE FACTS ABOUT WESTINGHOUSE ELECTRIC—Continued**

Bridgeport, Conn., works of the Bryant Electric Company, manufacturers of switches and electrical wiring devices of all kinds. Covers 500,000 square feet of floor space.

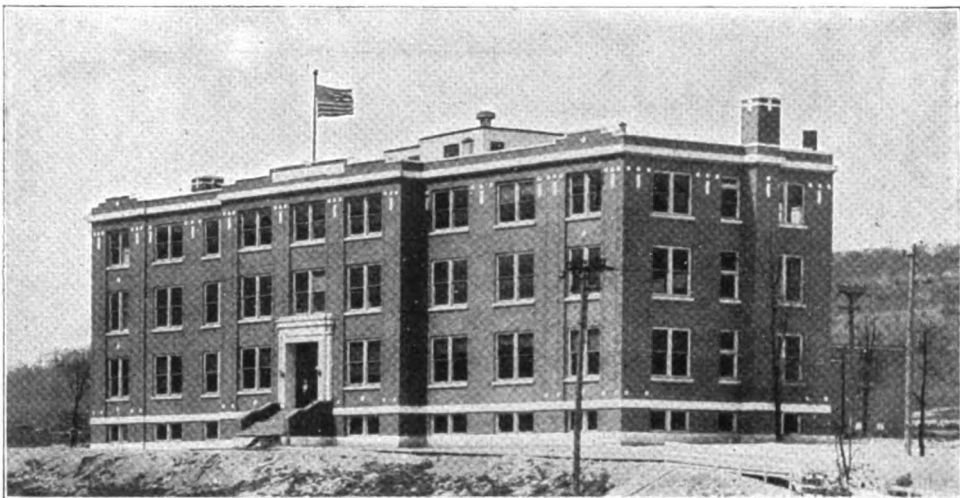
Bloomfield, N. J., Milwaukee, Wis., Trenton, N. J., Middletown, Conn., Indianapolis, Ind., and Brooklyn, N. Y., works of the Westinghouse Lamp Company, a subsidiary organization, employing 4,000 persons engaged in the manufacture of incandescent lamps, and utilizing a floor space of 1,500,000 square feet.

Pittsburgh, Pa., works of the R. D. Nuttall Company, manufacturers of tractor, industrial, and railway gearing, expansion joints, flexible couplings and current-collecting trolleys. Employs 500 people.

Pittsburgh, Pa., works of the Pittsburgh Meter Company, manufacturers of water, gas, and air meters. Employs 500 people.

### **Striding Ahead to the Future**

It has never been the aim of the Westinghouse Electric & Manufacturing Company merely to be great in size. Its first purpose has been greatness of achievement and service. To this end it is ceaselessly working for the extension of electricity into new fields, for the improvement of present methods and apparatus, and for the invention and perfection of new apparatus and machinery. While one part of the vast Westinghouse organization is producing today's goods, another is striding ahead towards the future, so that when tomorrow comes Westinghouse shall be ready.



**Research Building, East Pittsburgh, Pa.**

*“So that when tomorrow comes Westinghouse shall be ready.”*



## **WESTINGHOUSE BUILDING**

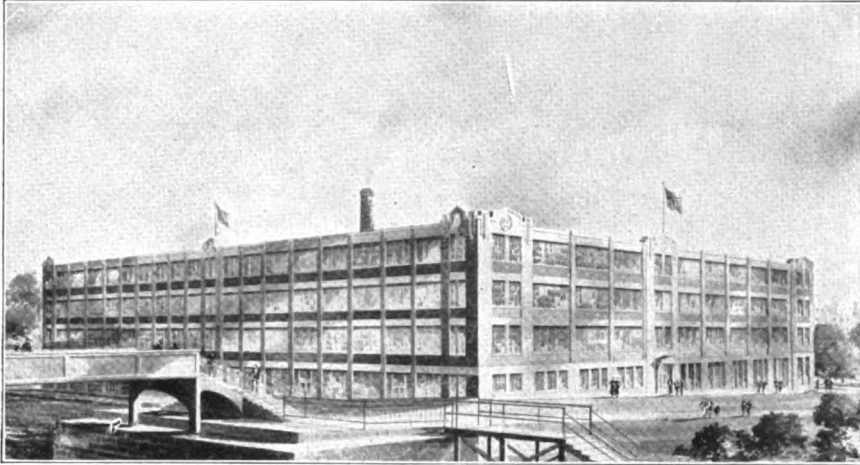
**Broadway and Liberty Street, New York**

*(Now in course of erection)*

**For the New York Executive and Sales Offices  
of Westinghouse Electric and Mfg. Co.,  
and Allied Companies**



## A NEW IDEA IN SERVICE



The Homewood, Pa. Plant of the Westinghouse Electric and Mfg. Co. as it will appear when all the units are completed. Devoted exclusively to the manufacture of repair and renewal parts for Westinghouse apparatus in service, but of designs no longer strictly standard.



## WESTINGHOUSE ELECTRIC COMBINATION SALES, SERVICE AND WAREHOUSE BUILDINGS

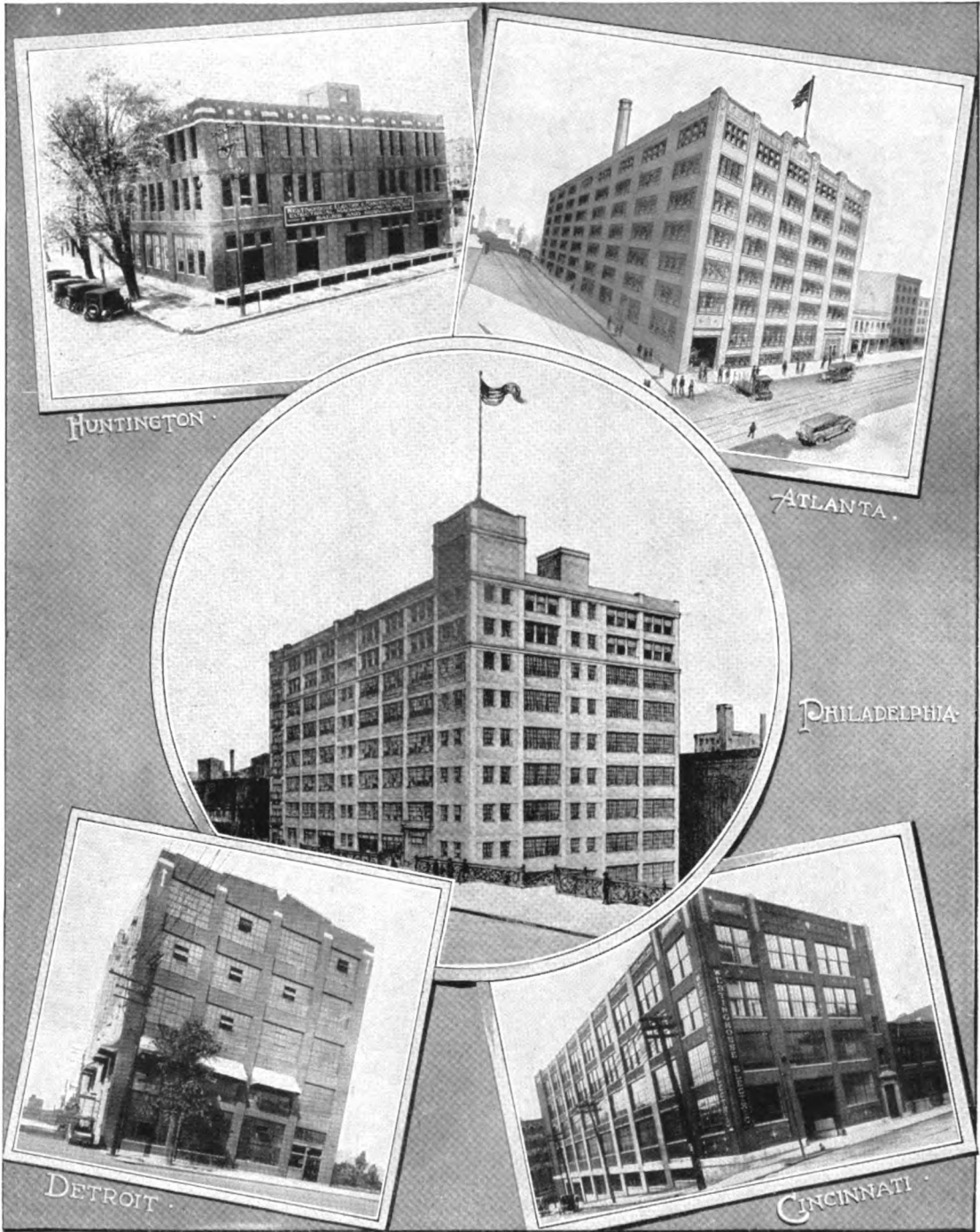
*(See pages xii and xiii, following)*

**T**HE two pages immediately following show some of the new Westinghouse Electric Combination Sales, Service and Warehouse Buildings either recently completed, or now in course of erection.

These buildings, located at important distribution centers throughout the country, are designed to bring together and coordinate under a single roof all the local facilities of the Westinghouse organization for prompt and efficient service. They are but another evidence of the constant effort of the Westinghouse Electric & Manufacturing Company to more completely serve its customers.



*On this page and the one following are shown some of the new Westinghouse Electric Combination Sales, Service and Warehouse Buildings*



*On this page and the one preceding are shown some of the new Westinghouse Electric Combination Sales, Service and Warehouse Buildings*

# How This Catalogue Serves



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# How This Catalogue Serves



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For a complete list of electrical supplies, see "Subject Index," pages xix to xxxii

## ORDERING INSTRUCTIONS

**T**O AVOID delays and misunderstandings, note carefully the following points:

1. Send all **correspondence** and **orders** to the nearest office of the Company or the nearest agent-jobber (see list on inside of front cover).
2. When ordering **give style number** and complete description. If modification of standard apparatus is desired, order "Similar to Style No. .... except (state modification)."
3. In **ordering duplicate** of apparatus not listed, order by the style number or stock order (S. O.) number (one of these numbers is cast or marked on the apparatus). Also give the **serial number** and full description.
4. In ordering **parts**, give style number, complete description, and serial number of the complete apparatus.
5. State whether **shipment** is to be made by freight, express, (and name the route), or by parcel post. In the absence of instructions, goods will be shipped at our discretion. Shipments ordered by parcel post will be insured only on request. All shipments are at purchaser's risk.
6. Present all **claims for breakage** to the carrier, as we are not responsible for breakage after delivery of goods in good order to the carrier. If we are notified of such claims, however, we shall gladly lend assistance to secure adjustment.
7. Make **claims for shortage** within five days after receipt of shipment; otherwise they will not be entertained.
8. Do not **return goods** to us for credit or exchange without first obtaining written approval with shipping directions from the office through which the order was placed. Notifications of such shipment, with copy of the shipping receipt, must be sent to the district office. The shipment must bear the name and address of the sender. Otherwise, we cannot accept responsibility for credit.
9. **When referring to an order**, always mention the number and date of your order and the name of the consignee.
10. **Prices** in this catalogue are approximately correct at time of issue, and are subject to changes without notice. They are included for convenience in estimating and are **not offered as a quotation**. Exact prices for any apparatus listed will be quoted on request. See "Approximate Cost Multipliers" on page xviii (second page following).
11. **Terms** are such as the company may extend to the purchaser, not to exceed net cash in thirty days from date of shipment.
12. Small orders should be combined so as to amount to a value of at least \$1.00 net, as no invoice will be rendered for an amount less than \$1.00. Where the total of the sale is less than this, the material will be invoiced at \$1.00.
13. The Company will not be responsible or liable for any loss, damage, detention or delay caused by fire, strike, civil or military authority, or by insurrection or riot, or by any other cause which is unavoidable or beyond its reasonable control; nor in any event for consequential damages.

# APPROXIMATE COST MULTIPLIERS

(See page xviii)



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(See page xix)



## STYLE NUMBER INDEX

(See page 1289)

**DISCOUNTS giving SALES PRICES can be obtained from NEAREST REPRESENTATIVE**

(See list on inside of front cover)

**ESTIMATING MULTIPLIERS to obtain APPROXIMATE COSTS are given below**

Example—Style No. 363859; page 515, list price.....\$24.00  
 Approximate Cost Multiplier for page 515 ..... .76  
 Approximate Cost (.76 x \$24.00) ..... 18.24

Section	Page	Description	Approx. Cost Mult.	Dis- count	Section	Page	Description	Approx. Cost Mult.	Dis- count
1-A	6-33	Lightning Arresters.....	.60	Trade, Quantity and Resale Discounts Furnished, on Request, by nearest Representative. See List Inside of Front Cover	5-B	704-705	All Material.....	.50	Trade, Quantity and Resale Discounts Furnished, on Request, by nearest Representative. See List Inside of Front Cover
	48-52	Choke Coils.....	.60			706-708	Insulating Oils.....	On request	
	56	Static Condensers.....	.60			710	Oil Testing Service.....	.50	
1-B	58-59	Potential Transformer Fuses and Fuse Blocks.....	.60		711-712	Babbitts and Solders.....	On request		
	60	Current Limiting Resistors..	.60		716-717	All Material.....	.60		
	63-67	Distribution Transformer Fuse Blocks.....	.60		718-725	All Material.....	.70		
	68-69	Enclosed Cartridge Fuses...	.95		726	All Material.....	.60		
	69	Enclosed Cartridge Fuse Bases.....	.60		727	All Material.....	.55		
	70	Expulsion-Type Fuse Blocks..	.66		728	Types F and FP Ears.....	.60		
	72	Type R Power Fuses.....	.66		729	Bronze Feeder Ears.....	.55		
	74	Motor Starting Knife Switches.....	.66		730	Strain Ears.....	.60		
	76	Field-Discharge Switches and Transfer Switches.....	.66		731-739	Half Strain Ears and Strain Plates.....	.60		
	79	Back-of-Board Knife Switches	.60		740-741	Bronze Strain Ears and Cleveland Splicers.....	.55		
81	Instrument Switches.....	.66	742		All Material.....	.55			
87	Motor-Operated Snap Switch	.60	6-B		743	All Material.....	.70		
89	Automatic Temperature Control.....	.60			744-746	Type CB Suspension and Type F Ear.....	.55		
90	Thermal Relays.....	.60			743	Catenary Hangers.....	.70		
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	116	Type T Horn-Gap Switch.....	.60		743	Type FC Hangers.....	.60		
	118	Farm Line-Switches.....	.60	743	All Material.....	.70			
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2-A	271-355	Switchboards.....	.60	6-D	750-754	All Material.....	On request		
2-B	363-365	Generator-Voltage Regulators	.25	6-E	755-766	All Material.....	.60		
	368	Arc-Furnace Regulators.....	.25	7-A	773-806	Porcelain Insulators.....	.60		
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	385-482	Switchboard Accessories.....	.50	8-B	875-936	Ornamental Street Lighting Equipment.....	.80		
3-B	483-501	Watt-hour Meters.....	.82	8-C	937-948	Lighting Transformers.....	.65		
	506	BT Ammeter.....	1.00	8-D	949-958	Arc Lamps.....	On request		
	507	BI Ammeter.....	.80	4-A	967-990	Industrial Lighting Equip-ment.....	1.00		
	571-598	Relays.....	.76	991-998	Safety Motor Starting Switches.....	1.00			
4-A	502-504	All other apparatus.....	.76	41-A	999-1000	Industrial Safety Switches...	1.00		
	508-570			1001-1003	Safety Auto-Lock Switches...	1.00			
599-616			1004-1005	Mine Safety Switches.....	1.00				
4-B	628-652	Distribution Transformers...	.75	1006-1014	Safety Service Switches.....	.88			
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5-A	676-684	Feeder-Voltage Regulators...	.90	1015-1018	Renewable Fuses.....	1.00			
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		No. 21-D and 21-M Micarta Plate.....	.60	1059-1060	Fuse Blocks.....	.65			
		No. 213, 217, 21-H Micarta Plate.....	.47	1059-1060	Fuse Holders.....	.60			
		No. 238 Micarta Plate.....	.94	1061	Aluminum Fuse Wire.....	.65			
		Micarta Rod.....	.50	1061	Nickel-Silver Fuse Wire.....	.70			
		No. 121 Micarta Pump Washers.....	.77	1061	Alloy Fuse Wire & Ribbon...	1.00			
		No. 21-D Micarta Pump Washers.....	.85	1062	Conduit Bushings.....	1.00			
	690	Micarta Tubing.....	.80	1063-1076	Solderless Connectors (Frankel).....	.80			
	691	No. 21-M Micarta Gear Blanks.....	.85	1077	Bell Ringers.....	On request			
	693	No. 210 Mica Plate.....	.50	1078-1079	Charging Plugs and Receptacles.....	.70			
	694	No. 207, 209, 237 Mica Plate	.50	1080-1081	Plugs and Receptacles.....	.75			
		No. 224, 232, 240, 241 Mica Plate.....	.55	1082	Machine-Formed Cut-Out Boxes.....	1.12			
		No. 308 Mica Plate.....	.60	1083-1087	Hand-Formed Cut-Out Boxes	1.10			
		No. 251 Mica Plate.....	.40	1088	Toggle Bolts.....	.90			
	No. 229 Mica Plate.....	.80	41-E	1089	Tapes and Splicing Com-pounds.....	On request			
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	No. 240 Mica Tape.....	.50	43-A	1107-1118	Rectifier Outfits.....	1.00			
	Mica Tubes.....	.40	43-B	1119-1126	Rectigons.....	1.00			
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698	All Material.....	.60	44-B	1152-1160	Electric Ranges.....	On request			
699	All Material.....	.50	45-A	1161-1178	Electric Fans.....	On request			
			46-A	1180-1184	Light and Power Plants.....	On request			
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## SOME FACTS ABOUT LIGHTNING

### General

The insulation of apparatus connected to electric systems is subject not only to the continuous stress of line voltage but also to occasional transient stresses due to atmospheric or system disturbances. These transient stresses are variable but frequently sufficient in intensity to injure or even to puncture the insulation of the apparatus. It is not possible to prevent or control the phenomena which cause the stresses. It is, therefore, necessary to provide protective equipment which will maintain service by preventing damage to the insulation.

The protection of apparatus insulation against damage by strictly transient over-voltage (from any source) and the consequent reduction in service failures are the functions of lightning arresters.

The dangerous phenomena consist in general of the release on the system of free, or uncontrolled energy. The causes may be broadly divided into two classes, viz., external or atmospheric, and internal or system disturbances.

External or atmospheric disturbances arise from the gradual accumulation of charges on clouds, and their subsequent discharge. Charges are impressed on the system in various ways the most important of which are direct strokes and release of bound charges.

Internal or system disturbances ordinarily consist either in the discharge on the system of the energy of magnetic fields of apparatus at the time of switching, or in the re-adjustment required when some capacitance, as a cable, is connected to the system. Since such disturbances result from switching operations they are generally known as "switching surges."

In any case, the energy of the transient is comparatively low but the voltage may be high and the power flow, since it is limited only by the circuit impedances, may also be high. This means, of course, that the duration of the disturbance is short.

The fact that the phenomena are transient, of short duration, and extremely variable makes direct study of their characteristics difficult if not impossible. Indications as to their character and as to the scope of their variation are available from tests, observations of their results and consideration of circuit characteristics. Some of these indications are given for their value as a scale with which to measure the protection problem, but they must be considered as broad approximations resulting from the study of rather indefinite data.

**Direct Strokes**—In the case of direct strokes, where the discharge from cloud to ground terminates in the electrical system, the rate of power flow is so high as to be destructive regardless of protective means. Whatever is struck, pole, conductor, transformer or arrester, is very likely to be destroyed. While this sort of disturbance is within the sphere of lightning arrester application, no device has yet

been made which will afford protection. Little is known as to the actual intensity of direct strokes except that they are far beyond the range of protective equipment.

**Bound Charges**—The release of bound charges on the system by cloud to cloud or cloud to earth discharges is the most frequent source of trouble with atmospheric disturbances. Portions of lines up to several miles in length may be charged to voltages of several hundred thousand and when the cloud discharge takes place the energy of this line charge is free to travel along the system.

**Switching Surges**—Internal disturbances in general are less severe than those of atmospheric origin, but even here the danger to insulation is appreciable. The voltages involved are considerably less than the maximum of those due to atmospheric disturbance but still sufficiently high to be dangerous.

**Surge Characteristics**—Taking (as a starting point), an arbitrary maximum transient voltage of 400,000 volts, some interesting conclusions can be drawn as to the performance of specific arrester types and as to the necessary arrester characteristics for the desired performance. The maximum values of transient current and voltage are directly related to each other through the characteristics of the line as expressed by the value for the surge impedance for that line. The surge impedance depends on the inductance and capacity per unit length of line ( $\sqrt{\frac{L}{C}}$ ). For ordinary overhead construction, this value varies from 300 to 600 ohms. The lower values are normal for the lower voltage lines. In the assumed case, then, with a surge impedance of, say, 400 ohms and a maximum value of transient voltage of 400,000, the maximum current will be 1000 amperes.

When an arrester is connected from line to ground the surge, on reaching the arrester may flow along the line or through the arrester. In reality it divides, and flows through both paths. The portion flowing in each path depends on the relative impedances of the paths. Accurately enough for general considerations, the resultant voltage at the arrester, and thus on the apparatus being protected, is related to the surge voltage as the arrester impedance is to the surge impedance of the circuit. Thus, in the assumed case, with a 400,000-volt surge and a line of surge impedance of 400 ohms, a 10-ohm arrester will reduce the voltage to approximately one-fortieth the original value or to 10,000 volts; a 100-ohm arrester will reduce the voltage to approximately 100,000 volts. These assumed figures are fairly representative of low-voltage distribution circuits, and hence, may be taken as indicative of the type of arresters required for satisfactory protection.

**Ground Connections**—This typical case, besides illustrating the need for low resistance arresters, brings out clearly the importance of grounds of permanently low resistance. It is the total imped-

## SOME FACTS ABOUT LIGHTNING—Continued

ance to flow of surge current which controls protection. The best arrester cannot be effective without a good ground connection.

Detailed descriptions of effective means for making ground connections are given on page 53.

**Lightning Arresters**

**Function**—The function of a lightning arrester is to protect the apparatus insulation by holding the transient voltage to a safe value for the insulation being protected. The general means adopted is to provide in the lightning arrester shunt paths to ground and between lines so arranged as to take little if any current from the line under normal conditions, but on the occasion of a transient or surge to take considerable current. Dangerous surges are characterized by a high voltage and a steep wave front. An arrester may act in response to an increase in voltage, as is usually the case, or to an increase in rate of change of voltage (steepness of wave front), as in the case of some few devices. With one device, the type AL arrester, both characteristics are used and the arrester acts in response to over voltage modified by steepness of wave front.

**Necessary Characteristics**—The value of an arrester from the protective standpoint depends on the extent to which surge voltages are prevented from rising.

For good performance it is essential:

1. That the "Initial relief voltage" or voltage at which the arrester begins to function, be safe for the insulation being protected.
2. That the impedance to flow of surge current be low in comparison to the surge impedance of the circuit with which it is to be used.

In addition to these two characteristics, it is necessary that an arrester shall not cause line disturbances by excessive flow of current due to line voltage. It must also be ready to perform its function whenever surges come.

Besides the requirements in regard to protection, lightning arresters are subject to economic limitations from the fact that they are, in a manner, an accessory to the performing apparatus. The expense of first cost, installation and maintenance must be justified by the savings in the prevention of injuries (damage) to apparatus or interruption to service.

**Arrester Types**—Two main types of arresters have been extensively used; namely, the gap and resistance type (including the multigap types) and the valve type. In the **gap and resistance type**, after the gaps have been broken down, the current flow is proportional to the voltage. The design of such an arrester is a compromise between the requirements for low impedance from the standpoint of the surge, and for high impedance from the standpoint of power current. In the **valve type**, the current flow is proportional to the excess voltage, no current flows due to line voltage. In this type the only design limitations are economic. Low impedance has no disadvantages.

Experience has shown that gap and resistance type arresters do not completely meet the needs of service, since sufficiently low impedance to flow of surge current cannot be secured without excessive flow of power current. This type is usually less expensive than the valve type, however, and there are, therefore, some cases where economic factors make the use of gap and resistance arresters justifiable.

Arresters of the valve type offer the possibility of sufficiently low impedance to flow of surge current without performance disadvantages. It is to be expected that their use will continue to become more general.

In addition to these two general types, there are two devices, acting in response to rate of change of voltage, which find application. First, the condenser type arrester is used on direct currents, where application conditions are correct, and second, the choke coil is a valuable adjunct to arresters in practically every application.

**Electrolytic Arresters**—The electrolytic arrester is the best known, and most fully developed of the valve type arresters. It consists essentially of a series, or stack of cup-shaped aluminum trays, each of which contains electrolyte. This stack is connected, with a gap in series, from line to ground. When line voltage is applied to the stack, as in charging, a film is electrolytically built up on the surface of the aluminum. This film is of a nature which provides a large electrostatic capacity and also acts as an over-voltage valve. When an over-voltage is applied, as by a surge which breaks down the series gap, the capacity is first charged to line potential which is the same as the critical voltage of the cell, thus absorbing the energy of the first part of the surge, and then, as the voltage continues to increase, the film breaks down and current flows due to the excess voltage but is limited by the resistance of the arrester and ground. The electrolyte resistance and the cooling effect of the mass of electrolyte prevent the formation of arcs and the consequent destruction of the electrolytic counter e.m.f. effect.

The performance of this type of arrester is the best of any yet developed. The only disadvantages are economic, and consist of a comparatively high initial cost, which is consistent with the high grade of protection afforded, and the necessity for periodic charging and maintenance.

Detailed description and listings are given on pages 8, 9, 10 and 21 to 46 inclusive.

**Autovalue Arresters** — The autovalue arrester was developed to provide a valve-type arrester not subject to the economic limitations of the electrolytic but still maintaining the same high grade performance characteristics. Essentially, it consists of a stack or column of flat circular discs of material with comparatively high resistivity, separated by thin insulating washers and connected through a series gap between the line and ground. Even though the resistivity is comparatively high the



## SOME FACTS ABOUT LIGHTNING—Continued

resistance through which the discharge has to flow is low since the discs are thin and have a large area. At normal line voltage with no series gap there is a very small leakage current. At voltages above a critical value, slightly in excess of line voltage, the short gaps between the discs break down, and current flows due to the excess voltage but is limited by the resistance between the plane surfaces of the discs. The resistivity of the discs does not permit concentration of the current in any small area, but keeps the current flow between discs in the form of a glow discharge, thus preventing local heating with the consequent formation of arcs. The breakdown voltage of the minute gaps between discs and the voltage of the glow discharges are equal. Thus when voltages in excess of the critical value are applied, as by a surge which breaks down the series gap, the disc gaps break down, after which a constant voltage equal to the critical voltage is maintained in the gaps: the current flow is that due to the voltage applied to the disc resistance, which is the excess over the critical value. When the voltage falls to the critical value, the current becomes zero, and therefore no dynamic or line current flows.

Performance characteristics can be controlled by design, limited only by application requirements and economic considerations. As in the case of the electrolytic arrester, the critical voltage is proportioned to the line voltage by the use of the proper number of elements in series. The desired resistance of the structure is secured by the use of the required disc area, holding the resistivity at the value necessary to keep the discharge distributed.

Detailed description and listings of the sizes now available are given on pages 11 to 15 inclusive and page 20.

**The Multi-Gap Arrester** consists essentially of spark gaps and resistances. The actual arrangement consists of series gaps; series gaps with series resistance; gaps shunted by resistance; series resistance or series gaps; and resistance shunted gaps. The function of the series gaps is to control the relief or critical voltage; and, with the shunted gaps, to rupture the dynamic arc that follows the surge. The series resistance is to limit the dynamic current and to prevent a short circuit.

The gap electrodes are of non-arcing metal mounted on porcelain holders. The resistances are in the form of non-inductive rods that are not sensitive to temperature or frequency.

The operation of the arrester is as follows: when, due to a surge, the voltage on the arrester rises above its relief voltage, the series gaps are bridged by a spark and the discharge passes through the shunt and series resistances to ground. If this is not sufficient relief, the voltage continues to rise until the shunted gaps are broken down. This increases the discharge capacity. The discharge starts an arc of dynamic current across the gaps which is extinguished at the first succeeding zero of the wave.

The discharge characteristic can be controlled by

design except that unlimited discharge capacity is not economically practical. This limitation means that multi-gap arresters cannot be designed to furnish as high a degree of protection as the best arresters of the valve type. However, it does give moderately good protection with moderate cost, low maintenance, and no attendance. Its field is the protection of smaller substations where the greater expense, maintenance and attendance of the better grade of valve type arresters is not warranted.

Detailed description and listings are given on pages 15 to 18 inclusive.

**Condenser Arresters** — The condenser arrester consists of an electrostatic condenser connected, with or without a series gap, from line to ground. It is applied on direct-current circuits only. It acts, as does the capacity of an electrolytic arrester, to absorb the energy of the surge up to its capacity. There is a theoretical limitation to the application of this type of arrester; namely, when great lengths of line are charged to very high voltages the energy content of the surge may be sufficient to overcharge the condenser and build up a voltage dangerous to the condenser or the apparatus.

No maintenance, adaptability to mounting in any location on car or pole, and the former good service results given, make this type of arrester attractive where conditions are proper for its application.

Additional description and listings are given on pages 6 and 7.

### Choke Coils

The steep wave front or "high frequency" characteristic of surges is made use of in protecting systems by the connection of a choke coil or inductance in series with the line between the apparatus to be protected and the lightning arrester. Such a device is not sufficient in itself to give adequate protection against injury by surge voltages but it does form a valuable adjunct to the lightning arrester in that a portion of the incoming surge is reflected back on the line, thus increasing the voltage applied to the arrester and assisting in overcoming any tendency toward time lag in breakdown which the arrester may have. In addition the inductance of the coil reduces the steepness of the wave front of that portion of the surge which passes through the coil; also, it delays the time when the voltage across the apparatus insulation is built up to the voltage permitted by the arrester and in the case of surges of very short duration it may even prevent this voltage from building up to full value.

Additional description and listings are given on pages 47 to 52 inclusive.

### Application of Protective Devices

**Controlling Factors** — In any specific problem of lightning arrester application, the main factors to be considered are:

1. The liability of the apparatus to damage by surge voltage; i.e., insulation failure.

## SOME FACTS ABOUT LIGHTNING—Continued

2. The cost and replacement expense of apparatus and the interruption of service due to insulation failures.
3. The cost, initial and maintenance, of the various available protective devices with their various degrees of protection.

**Liability to Failure** — Atmospheric disturbance conditions vary widely in different localities and it is difficult to determine, except in a most general way, to what extent atmospheric lightning troubles may be expected. Thus, mountainous districts are more subject to atmospheric lightning than plains. Frequent displays of visible discharges are an indication of severe conditions, but these are merely indications that lightning is to be anticipated and do not give any measure of the severity to be expected. Experience on the system in question or on nearby or similar systems is the nearest approach to a guide.

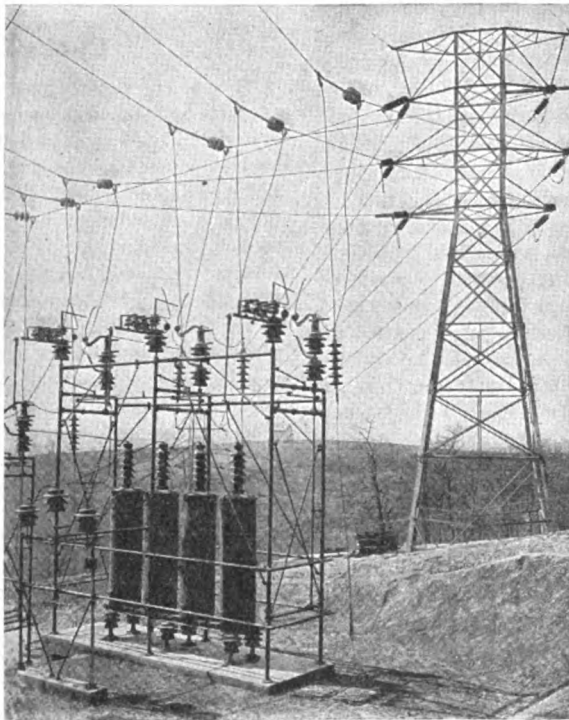
Different types of apparatus have different factors of safety of insulation and this materially affects the liability to failure. For example, the closer space limitation in rotating machinery makes for a tendency toward lower factors of safety than in such apparatus as transformers. Air-blast transformers have lower dielectric spark lag than oil-insulated types and are thus more susceptible to surge over

voltages. Low voltage transformers have a greater percentage factor of safety than high voltage transformers. Very small capacity transformers are more susceptible than the larger sizes because of space limitations. Old insulation is weaker than new; old designs are not so well proportioned as regards voltage distribution.

**Cost of Failure** — Insulation failures are of varying degrees of importance depending on the value and service conditions of the apparatus. Obviously, it costs more to repair or replace a large than a small transformer. Likewise, the labor of repair or replacement is greater in the case of distant and isolated installations. Contingent losses also vary. A service failure of a transformer supplying a lighting load in a single or a few homes is less than the failure of a transformer serving an industry where a shut down spoils the product in process as well as stopping production.

These are some of the factors which must be considered in determining the cost of failures in apparatus and service.

**Cost of Protection** — Balanced against these factors and taking into account the degree of protection expected, is the initial and maintenance cost of protective apparatus.



TYPE AL (IMPULSE-GAP) LIGHTNING ARRESTER FOR 73,000-VOLT SERVICE

## DIRECT-CURRENT LIGHTNING ARRESTERS

### Application

The major application for Westinghouse direct-current lightning arresters is in railway and industrial service.

In general, arresters of maximum protective capacity are required because the apparatus to be protected usually consists of motors, generators, or rotary converters in which the factor of safety of the insulation is less than in the general run of alternating-current equipment. Surge voltages must be held very close to the line voltage, and this requires that both the initial relief voltage and arrester impedance be low. On the other hand in many cases no ground resistance can be taken into account since one side of the line is directly grounded and the arresters are connected directly across the apparatus to be protected.

In general, a railway system requires protection at the station and on all cars and locomotives. It is a good plan to supplement this direct protection of generators and motors with arresters spaced about five per mile on the poles along the line, particularly where lightning conditions are severe.

**Station Arresters** — The station equipment is susceptible to damage by surge voltages, because it is rotating apparatus connected directly to the line, generally at the line end. The results of failure are especially serious due to the high value of the apparatus and because a failure usually affects the operation of the whole system. Therefore the best possible protection is warranted.

Maximum protection is afforded by the type A electrolytic arrester.

An alternative requiring less maintenance is the type AR arrester. Since this type has a higher discharge resistance, or, in other words, lower discharge

current capacity, it is desirable to install multiple units at important stations. A good rule is the installation of one AR arrester for each 500 kw. of generator capacity.

With either type the arrester should be supplemented by a choke coil and an arrester and coil should be used in each incoming line.

**Car-Mounting Arresters** — The conditions of application on cars are similar to those at stations except that the consequences of failure are less serious. The apparatus involved is on a single vehicle, and both cost of repair and contingent troubles are less than in the case of a station.

The most complete protection is afforded by the type AR electrolytic arresters, supplemented by a suitable choke coil.

Where the saving and maintenance expense and a greater ease of mounting justify the hazard of possible failure under conditions of extreme severity the type K-3 arrester may be applied and will give good service. For most installations the arrester should be supplemented by a suitable choke coil.

The types AR and K-3 arresters are particularly applicable where lightning conditions are very severe such as in interurban service.

Where lightning conditions are not very severe, such as in city service, the somewhat less effective type MP arrester may be applied, using one or two arresters on each car.

**For Pole Mounting** — The types K-3 and MP arresters should, in general, be used to supplement the direct protection of the station and car arresters by installing about five of one of these types of arresters per mile on the poles along the line.

**For mine haulage systems** the types MP and K-3 arresters are used where the line and trolley run above the ground, and upon mine locomotives.

### TYPE MP LIGHTNING ARRESTERS

#### 100 to 750 Volts Direct or Alternating Current for Car, Line, and Station Use

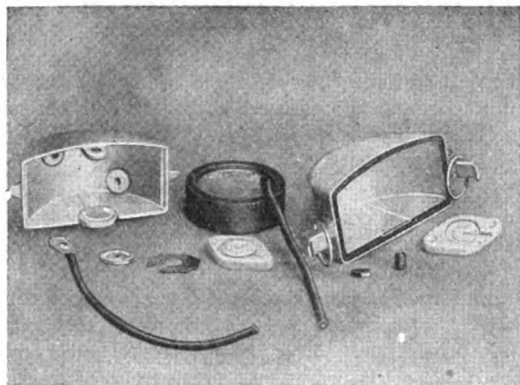
**Description**—The type MP arresters are provided for use on voltages from 100 to 750, alternating or direct current. They are especially adapted, however, for protection of direct-current railway motors or power motors, and are arranged for mounting on either car, pole, or wall.

The type MP (or multipath) arrester consists of ground and gauged particles of carborundum held together by a binding compound, and shaped in the form of a disc, with metal plate terminals at each side of the disc. The binding compound is a dielectric, and is broken down between particles in the operation of these arresters so that this carborundum block consists of many arcing paths between the particles of carborundum. At a rise in voltage above normal, due to a static charge on



STYLE NO. 47417—FOR CAR MOUNTING

## DIRECT-CURRENT LIGHTNING ARRESTERS—Continued



STYLE No. 154297—FOR POLE MOUNTING

the line, these gaps break down and provide a free discharge path to ground. Upon the voltage dropping to normal the arcs are broken, since they are so finely divided that they cannot be maintained at normal voltage and the size of the block is such as to carry off all discharges without heating. Since no generator current can follow the static discharge there is no noticeable surge such as caused by arresters which allow the power circuit to flow to ground and then disrupt it by mechanical means or magnetic blowout.

For voltages up to 400 the carborundum block is used without additional gap. For voltages from 400 to 750 the arrester includes a single small gap between broad metal points in series with the carborundum block. Both arresters discharge at a

lower rise above normal voltages than is possible with any other form of arrester, except the condenser and the electrolytic.

The only impedance to a static discharge in the MP arrester is the resistance of the arcs. This arrester has, therefore, a lower equivalent gap and a greater discharge capacity than any similar device, except the condenser and electrolytic types. The large diameter of the block gives a large cross-section of discharge path and a correspondingly large freedom of discharge.

These arresters are contained in cast-iron boxes, which are practically unbreakable. They are light in weight, small in size, and convenient, therefore, for handling and mounting. One-half of the casting can be easily removed, making access to the arrester easy for inspection or repairs. They are waterproof against rain or splashing of water from car wheels.

**Mounting**—Type MP arresters are furnished in two forms of mounting, as follows:

In the car mounting form the mounting lugs are on the top half of the casting, so that the arrester can be mounted on a floor sill. The bottom half can be opened for inspection.

When the arrester is mounted on the car roof a clearance of 4 inches is required for the removal of the lower half of the casting for inspection.

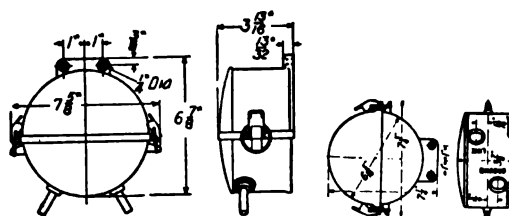
For line and wall mounting the arrester is supplied with the mounting lug on the bottom half of the casting. The upper half can be removed for inspection.

## Prices—Type MP Arresters

The style number and list price include the arresters complete and ready for installation.

Volts	Mounting	Style No.	List Price Each
100 to 400	On wall or pole	230110	\$9 15
100 to 400	On cars	269573	9 15
400 to 750	On wall or pole	154297	9 15
400 to 750	On cars	47417	9 15
Carborundum block, for use in any of above arresters.....		247950	1 80

Approximate weight of complete arrester  $7\frac{1}{2}$  pounds net, 9 pounds boxed for shipment.



These dimensions are for reference only. For official dimensions apply to nearest district office.

## TYPE K-3 LIGHTNING ARRESTERS

## For Voltages Up to 1500

## For Car, Line and Station Use—Railway and Lighting Circuits



TYPE K-3 WITHOUT SPARK GAP OR RESISTANCE

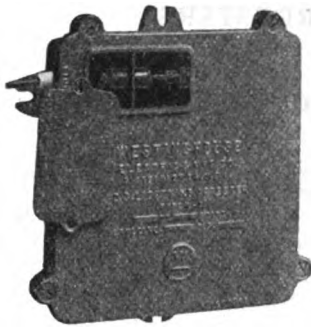
**Application**—The type K-3 is for line, car, and station protection on direct-current circuits of 100 to 1500 volts. It is especially applicable for protection of direct-current railway and power motors, and for direct-current generators and rotary converters. When properly connected it is also valuable in preventing flashovers on the commutator of rotary converters.

The type K-3 requires no attention except inspection.

This type of arrester should be used where local conditions are so severe that a higher degree of protection is justified than can be obtained with the lower-priced type MP arrester.

**Construction**—The type K-3 arrester is of the condenser type and is supplied in two forms: One form consists of a condenser alone; the other consists of a condenser in series with a spark-gap, the condenser being shunted by a high resistance.

DIRECT-CURRENT LIGHTNING ARRESTERS—Continued



TYPE K-3 WITH SPARK GAP AND RESISTANCE. SHOWING ACCESSIBILITY OF SPARK-GAP CHAMBER FOR INSPECTION

The condenser is of the flat-plate unit form in a moulded bakelite case. Its capacitance is one microfarad.

In the arrester without gap the condenser is connected directly across from line to ground. The condenser is charged to normal line voltage, but as soon as

static surges appear the condenser discharges these surges at any voltage above normal. The use of the arrester without gap is important in the protection of apparatus having weakened insulation. Many railway cars are operating with motors that will not stand a breakdown test at the voltage necessary to bridge an arrester gap, but with this type of arrester they are given protection.

In the arrester with gap the principal differences are that the condenser is always discharged and, therefore, affords a slightly increased capacity for discharge of any static wave of great volume. This arrester may be used with the gap short-circuited inasmuch as the resistance shunting the condenser is of such a high value that only a negligible amount of direct current can flow and no heating results.

General—The arrester is mounted in a rectangular cast-iron box with a waterproof cover. The spark-gap chamber of the form having a spark-gap is accessible by removing a small separate cover. The arrester can be easily mounted underneath the car or on the roof of the car, and is suitable for mounting in any position on car, pole, or wall.

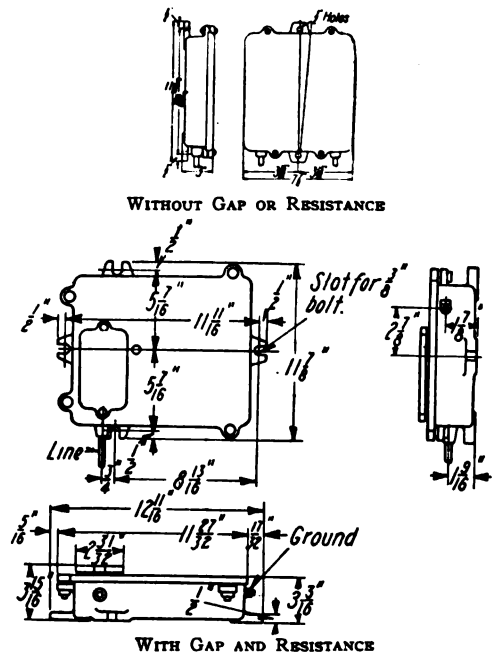
Testing—The only way in which the type K-3 arresters can fail is by the open-circuiting or short-circuiting of the condenser.

An open circuit is extremely improbable, but can be determined by charging and discharging the condenser and observing the spark. In the gap-

form of arrester with the gap open the condenser is kept discharged by the resistance and upon closing and opening the gap a spark of considerable intensity can be observed. In case the condenser is open-circuited and the resistance only in circuit, the spark will be very faint. In the type of arrester without gap or resistance the static spark through the condenser can only be observed upon making the circuit after breaking it and discharging the condenser. For this purpose the circuit should be opened between line and arrester, and the line lead from the arrester should be touched to any convenient ground thus short-circuiting the condenser and discharging it. With the condenser discharged the circuit to the line should be closed and the spark observed.

If the condenser has failed and has short-circuited it will probably have burned off a lead or blown a fuse, if there were a fuse in the arrester circuit.

Outline Dimensions



Prices—Type K-3 Lightning Arresters

Style number and list price include the arrester complete as described, ready for installation.

Volts	Description	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
100-1500	Without gap or resistance	23	42	256369	\$38 25
100-1500	With gap and resistance	26	45	256372	51 75
100-1500	Resistance Rod	..	..	186818	1 35

These dimensions are for reference only. For official dimensions apply to the nearest district office.

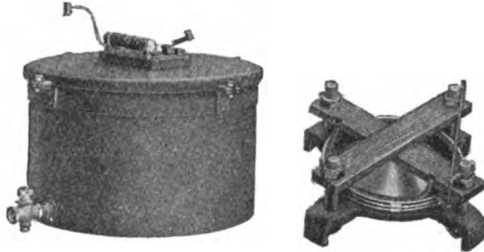
Order by Style Number

DIRECT-CURRENT LIGHTNING ARRESTERS—Continued

TYPE A ELECTROLYTIC LIGHTNING ARRESTERS

For Voltages Up to 2450

For Station Use—Railway and Lighting Circuits



TYPE A ELECTROLYTIC ARRESTER

**Description**—These arresters are for use in generating stations or substations up to 2450 volts, and are provided for indoor mounting only.

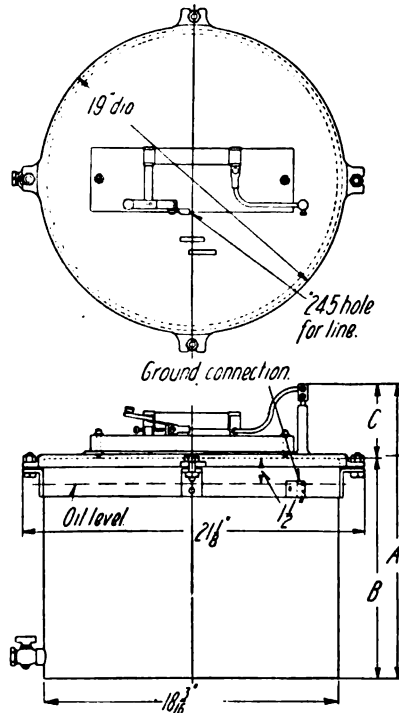
The type A electrolytic arrester is similar in construction to the type AK alternating-current arresters for higher voltages, described elsewhere, except that no charging resistance is required. The same aluminum trays are used. These trays are mounted in an iron tank of ample strength, and of such size as to provide sufficient oil for cooling purposes under all possible operating conditions. The area of aluminum tray or plate exposed to electrolyte is twice that of any other alternating-current aluminum arrester, and several times that of any other direct-current aluminum arrester, hence this type A arrester exceeds in discharge capacity any other arrester for similar service. It is not limited like competing types to any particular kilowatt capacity of circuit.

The type A arrester is provided with a fuse and with a gap for insulating the arrester from the line, both mounted on top of the tank. This gap can be easily short-circuited for the purpose of charging the arrester, which operation should be performed once a day. The arrester can be operated on direct current with the gap closed but in this case the leakage current disintegrates the aluminum trays

and the electrolyte, giving them a much shorter life than when a gap is used.

In addition to the daily charging of the arrester, it is necessary to inspect the condition of the trays and replace the electrolyte about once a year. If the arrester is used with gap short-circuited, this period should be reduced to once in six months.

Outline Dimensions



Dimensions in Inches

No. of Trays	A	B	C
2 to 4	15 1/4	11 1/4	4 1/2
5 to 8	17 1/4	13	4 1/2

Prices

The style number and list price includes the arrester complete and ready for installation.

Voltage	No. of Trays	Electro-lyte†	Gals. of Oil	APPROX. WT., Net	LBS.‡ Boxed	Style No.	List Price Each
0-350	2	1	9	42	72	201555	\$74 00
350-700	3	2	9	42	72	120830	78 00
700-1150	4	3	9	42	72	201556	83 00
1150-1400	5	4	13	42	83	201557	87 00
1400-1750	6	5	13	42	83	201558	91 00
1750-2100	7	6	13	42	83	185047	94 50
2100-2450	8	7	13	42	83	201559	99 00

Accessories

Type D electrolyte (8-ounce bottle).....	141539	50
--	--------	----

For other accessories see alternating-current electrolytic arresters.

†Number of bottles of electrolyte style No. 141539.

‡Weights do not include oil or electrolyte. net weight of oil 7 1/4 lbs. per gallon; shipping weight, 9 lbs. per gallon.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

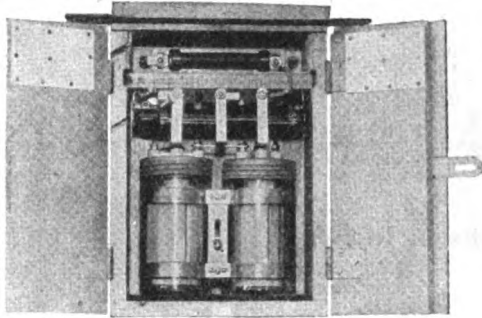
Order by Style Number

DIRECT-CURRENT LIGHTNING ARRESTERS—Continued

**TYPE AR ELECTROLYTIC LIGHTNING ARRESTERS**

For Voltages Up to 3800

For Car or Station Use; Railway, Power and Lighting Circuits



TYPE AR 650-VOLT CAR-MOUNTING DIRECT-CURRENT ELECTROLYTIC LIGHTNING ARRESTER

The type AR direct current electrolytic lightning arresters contain one or more cells. Each cell consists of two aluminum plates immersed in a suitable electrolyte and supported from a porcelain cover clamped by a zinc ring to a glass jar with a gasket placed between the porcelain cover and the glass jar. Hollow concentric cylinders made from sheet aluminum form the plates, the outer cylinder or plate being punched and upset at frequent intervals in order to allow free circulation of electrolyte within the cell. Balancing resistors are used with arresters of more than one cell. These resistors cause each cell to take its proper portion of the line voltage and thereby tends to keep the aluminum hydroxide films equally formed.

These arresters are "floated" between line and ground so that a leakage current of only a few milliamperes passes continually. This leakage current

serves to keep the film upon the aluminum plate or plates in proper order. The arrester is capable, however, of passing a surge current of approximately 1000 amperes at double normal voltage when the arrester is functioning. One arrester should be used for each 500 kilowatts of feeder bus, rotary converter, or motor generator capacity to which the arrester is connected. Any voltage in excess of normal line voltage is discharged promptly through the arrester. The functioning of this arrester, similar to the alternating-current electrolytic arresters, can be likened to the functioning of a steam safety valve or a hydraulic release valve. When the impressed pressure (voltage) exceeds the normal, the valve opens and the excess pressure (voltage) is relieved; then the valve closes, and is again ready for operation.

A fuse is placed in series with the arrester cells to prevent destruction of the arrester should a short or heavy discharge for an appreciable length of time occur.

Evaporation of the electrolyte in the cells is prevented by a layer of oil on the surface of the electrolyte.

The arresters are mounted and securely held in asbestos board and wool-fibre lined cypress boxes. The boxes with a flat top are intended for mounting beneath the car; with a slanting top for station, car interior, car roof, or outdoor mounting on any vertical flat surface. Although all arresters are inherently outdoor arresters, they can be used satisfactorily indoors.

The style number and list price include the arrester complete and ready for installation.

**Arresters**

Arrester Voltage	No. of Cells	APPROX. WT. LBS. WITH ELECTROLYTE AND OIL		CAR TYPE FLAT TOP BOX		STATION TYPE SLANTING TOP BOX	
		Net	Boxed	Style No.	List Price	Style No.	List Price
0-325	1	20	40	324164	\$ 24 00	324172	\$ 21 00
326-650	2	30	65	324165	38 35	324173	38 35
651-900	3	56	115	324166	53 00	324174	65 00
901-1350	5	68	130	324167	118 00	324175	144 00
1351-1700	6	95	225	324168	160 00	324176	160 00
1701-2100	8	140	250	324169	355 00	324177	355 00
2101-2600	10	170	300	324170	425 00	324178	425 00
2601-3800	12	275	350	324171	492 50	324179	492 50

**Accessories and Auxiliaries**

**Equipment**

Description	Style No.	List Price Each
Cell plates with cover	329632	\$5 00
Glass jar	323538	75
Clamping ring	323537	15
Gasket	329631	08
Wrench	329630	10
Balancing resistor	323994	2 70
Balancing resistor	324210*	3 00
Balancing resistor	324082	2 70

\*Balancing resistor style No. 324210 has a middle tap.

**Table of Balancing Resistors**

Arrester Voltage	No. of Cells	NUMBER OF BALANCING RESISTORS REQUIRED PER ARRESTER		
		Style No. 323994	Style No. 324210	Style No. 324082
0-325	1	None	None	None
326-650	2	None	None	None
651-900	3	None	1	1
901-1350	5	None	2	1
1351-1700	6	None	3	None
1701-2100	8	None	4	None
2101-2600	10	None	5	None
2601-3800	12	None	None	12

Order by Style Number

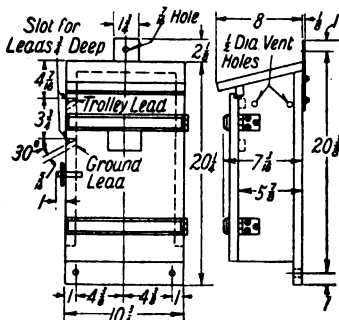
DIRECT-CURRENT LIGHTNING ARRESTERS—Continued

Oil and Electrolyte

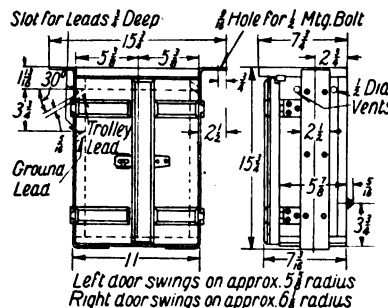
Arrestor Voltage	Quantity Ounces	OIL* Style No. (With Container)	List Price	TYPE D ELECTROLYTE LIQUID			Dry† No. of Pkgs. Req.
				Quantity	Style No.	List Price	
0-325	1	329633	\$0 25	1/4 gal.	329642	\$ 1 20	1
326-650	2	329634	30	1/2 gal.	329643	1 35	2
651-900	3	329635	35	3/4 gal.	329644	1 65	3
901-1350	5	329636	45	1 gal.	329645	2 20	5
1351-1700	6	329637	50	1 1/4 gal.	329646	2 40	6
1701-2100	8	329637	60	1 1/2 gal.	329647	2 95	8
2101-2600	10	329639	70	1 3/4 gal.	329648	3 45	10
2601-3800	12	329640	80	2 1/4 gal.	329649	3 95	12

\*For larger quantities of oil (Wemco A) refer to catalogue section 5-A on "Insulating Oils."  
 †Unless otherwise specified type D electrolyte will be shipped in the dry form; if liquid form is desired, so specify on order.  
 ‡For larger quantities of electrolyte refer to listings of alternating-current Electrolytic Arrestor Accessories.  
 †Package (one) type D dry electrolyte style No. 329641 will make 1/4 gallons of liquid electrolyte. List price \$ .33

Outline Dimensions in Inches



STYLE No. 324173

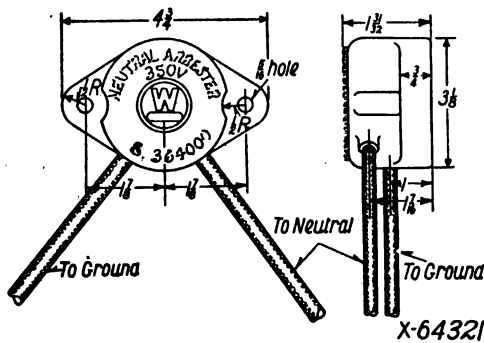


Left door swings on approx. 5 1/2 radius  
 Right door swings on approx. 6 1/2 radius  
 STYLE No. 324165

Outline dimensions of the 325-volt, 900-volt, 1350-volt, 1700-volt, 2100-volt, 2600-volt and 3800-volt arresters will be furnished upon request.  
 These dimensions are for reference only. For official dimensions apply to nearest district office.

NEUTRAL LIGHTNING ARRESTERS

For Distribution Circuits



X-64321

The neutral arrester is designed for the protection of the neutral wire of distribution transformers which are installed on grounded neutral systems where the neutral wire is grounded at the power station or sub-stations but not at the transformer stations.

This arrester consists essentially of a spark gap between non-arcing metal electrodes, one of which is a spherical section and the other a flat plate. The electrodes are separated by a porcelain spacer. The entire gap is mounted in a brown porcelain block which is provided with two 1/2-inch mounting holes. Leads of ample length for connection to the neutral wire and to the ground wire are provided.

PRICES

Style number and list price include the arrester complete with two 1/4-inch lag bolts for mounting and with leads for connecting to the neutral and to the ground wires.

Volts	APPROX. WEIGHT LBS. EACH	Standard Package	Style No.	List Price
	Net	Quantity		Each
0 to 300	1/4	3	364000	\$2 10

Order by Style Number



## TYPE LV AUTOVALVE DISTRIBUTION ARRESTERS

For Voltages up to 15,000  
For the Protection of Distribution Transformers

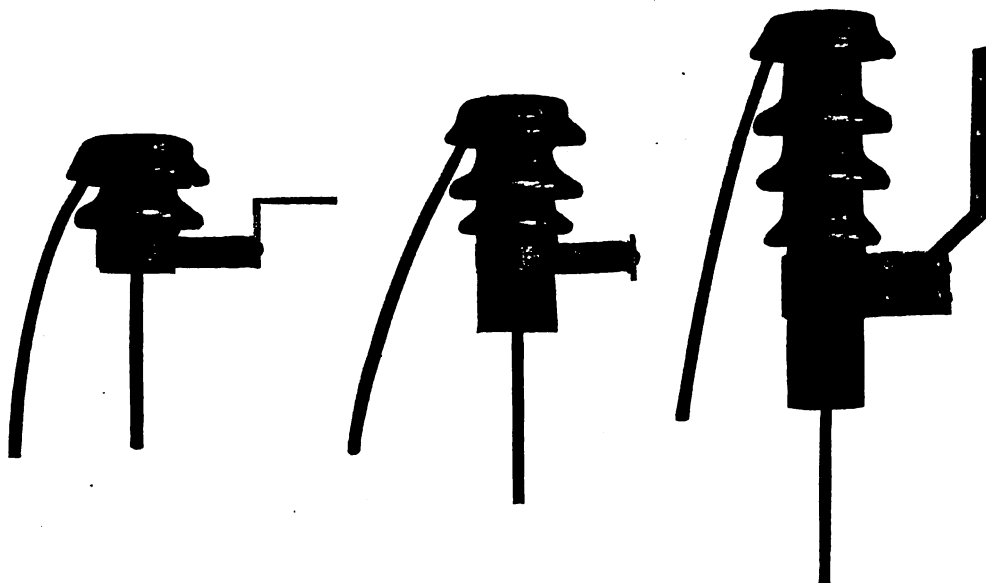


FIG. 1—2500-VOLT ARRESTER  
WITH FORM T MOUNTING BRACKET

FIG. 2—5000 AND 7500-VOLT  
ARRESTER WITH FORM H  
MOUNTING BRACKET

FIG. 3—12000 AND 15000-VOLT  
ARRESTER WITH FORM C  
MOUNTING BRACKET

### Application

The protection of distribution systems in general consists of the protection of the transformers. These transformers are distributed over a considerable area where frequent maintenance attention is impracticable. It is essential that arresters for the protection of distribution transformers be low enough in cost to warrant their use with even the smallest transformers, that the arrester be free from the necessity of periodic maintenance except for very infrequent inspections, and that they must be such as to permit ready mounting on the pole or cross arm. In addition to meeting these economic requirements, it is necessary that the protection afforded be of a high order. However, the requirements from the standpoint of protection are generally somewhat reduced by the fact that in locations where arresters are installed fairly densely over the system, the energy of a surge is taken care of by several arresters in multiple.

The performance requirements, then, are that the initial relief discharge voltage be at a value safe for the insulation being protected and that a sufficient number of arresters of any given quality be installed in a given area to give adequate discharge current capacity. The application of distribution arresters should be considered from the standpoint of the protection of the system rather than the protection of individual transformers. Each arrester installation should be made with a view to the conditions on the system in that im-

mediate locality. Except where lightning conditions are very mild, an isolated transformer will not be adequately protected by the installation of a single set of arresters, while the same transformer with the same arrester equipment in a district where other transformers and arresters are installed nearby would be adequately protected.

The basis for application of distribution arresters should be, in general, that except where lightning conditions are so mild as to warrant no arresters, protection should be provided for **each transformer**. In the case of isolated transformers, particularly where they are large in capacity or where continuity of service is of great importance, special protection should be provided in the form of added distribution arresters or in the use of station type instead of distribution arresters.

**Type LV (line autovalve) lightning arresters for distribution service** meet the requirements for this service more completely than any arrester heretofore offered. The initial relief discharge voltage is only slightly higher than line voltage. Although the impedance to flow of surge current is higher than in the larger arresters provided for station service, as is warranted by service and economic conditions, the value is still only a fraction of that for other distribution arresters offered at present.

Porcelain casings, sealed against the weather, small size, convenient method of mounting and

TYPE LV AUTOVALVE DISTRIBUTION ARRESTERS—Continued

arrangements of leads suited to ready connections under any conditions of mounting, make installation easy and inexpensive.

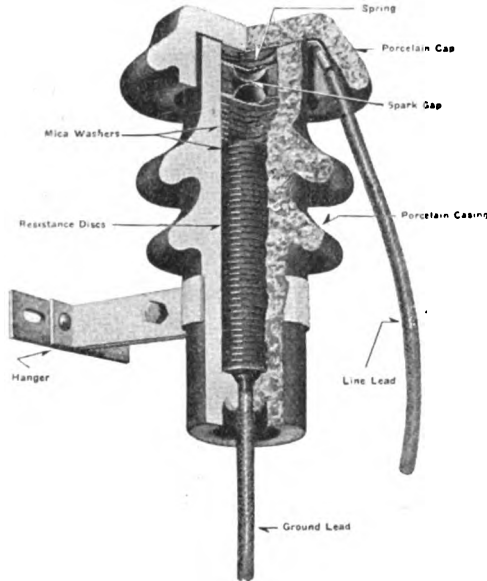


FIG. 4—CROSS SECTION OF 7500-VOLT ARRESTER WITH FORM H MOUNTING BRACKET

The Autovalve distribution arrester, the first of the valve type ever offered for distribution service is a marked advance in lightning protection.

Since no dynamic current flows in these arresters, the capacity of the power system or location of the arresters relative to the source of power need not be considered in applying these arresters. The only consideration, from the standpoint of power supply conditions, is that the line voltage must never exceed the maximum rated voltage of the arrester. Thus, the 2500-volt arrester may be applied with a neutral arrester on 4-wire 4000-volt grounded neutral systems since the line voltage across the arrester cannot rise higher than the rated value, 2500 volts. One arrester should be connected between the line lead and the arrester ground and a neutral arrester or spark gap should be connected between the neutral transformer lead and the arrester ground. On the other hand, when the line voltage may at times rise above the rated value of the arrester the application should not

be made. For example, on a three-phase 4000-volt grounded neutral system, where the neutral wire is not carried out to the service transformer, a ground on one phase may cause the voltage across the arresters on the other phases to rise above the normal value, 2500 volts. In such a case, three 5000-volt arresters should be used or four 2500-volt arresters using the multiplex connection.

On constant-current a-c. lighting circuits, Autovalve arresters may be applied, one arrester for each side of the circuit. The arrester applied should be one whose voltage rating is, at least equal to the open circuit voltage of the constant-current transformer.

Distinctive Features

These arresters, besides giving a very high quality performance, meet all requirements of the service for which they are designed as regards installation and maintenance. Various kinds of mounting brackets are provided to suit various installation conditions. Provision is made for mounting directly under the line wire, saving cross-arm room.

Installation is made easy by mounting the bracket first, then placing the arrester in the bracket.

The arrester may be turned in the bracket through any part of 360 degrees to bring the line lead to any desired position. The ground lead is brought out centrally through the bottom of the case. Both leads are well insulated. The mounting brackets are made of galvanized iron.

Construction

Autovalve distribution arresters are made in three sizes, for 2500, 7500, and 15,000 volts maximum. The 7500 and 15,000-volt sizes are also used, with a certain portion of the active elements omitted, for 5000 and 12,000-volt applications respectively. The arrester consists of a column of discs of the proper number for the line voltage, with a spark gap in series, all enclosed in a porcelain case from which leads of weatherproof insulated wire are brought out for line and ground connections.

The number of discs is chosen so as to make the voltage of discharge only slightly above the peak value of maximum rated line voltage, thus giving "close" protection. The disc area is large enough to make the total resistance of the disc structure very low. These arresters afford the greatest degree of protection of any offered for this service.

PRICES

Style number includes the arrester complete with leads but without mounting bracket. The mounting bracket must be ordered separately. List price includes arrester complete with any standard type of mounting bracket. Pierce clamps which may be used for mounting arresters equipped with Form C mounting brackets on wooden or angle-iron cross arms are listed in section on "Transmission Line Fittings."

Max. Voltage	Height	Dimensions in Inches Diam.	Length of Line Lead	WEIGHT POUNDS NOT INCLUDING MOUNTING BRACKETS		Style Number	Standard Package	List Price
				Net	Boxed			
2500	5 $\frac{3}{8}$	6	14	7	8	363254	12	\$10 50
5000	9 $\frac{1}{2}$	6	16	11 $\frac{1}{2}$	13	363271	6	23 00
7500	9 $\frac{3}{4}$	6	16	11 $\frac{1}{2}$	13	363255	6	33 00
12000	16 $\frac{1}{4}$	6	18	18	21	363272	3	38 00
15000	16 $\frac{1}{4}$	6	18	18	21	363256	3	50 00

Order by Style Number

TYPE LV AUTOVALVE DISTRIBUTION ARRESTERS—Continued

TYPICAL INSTALLATION DIAGRAMS

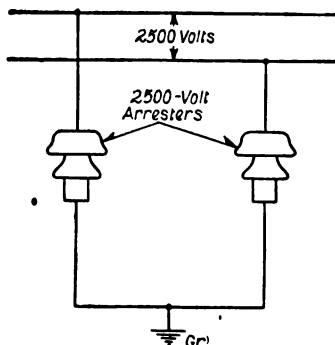


FIG. 5—SINGLE-PHASE, 2500-VOLT CIRCUIT  
NOTE:—For other voltages, use above connections and arresters rated at line voltage.

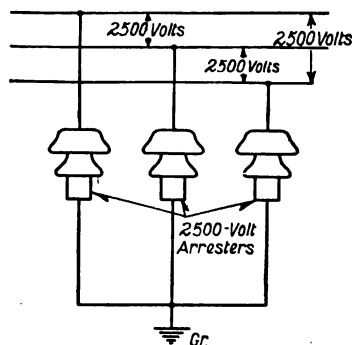


FIG. 6—THREE-PHASE, 2500-VOLT, THREE-WIRE UNGROUNDED CIRCUIT  
NOTE:—For other voltages, use above connections and arresters rated at line voltage.

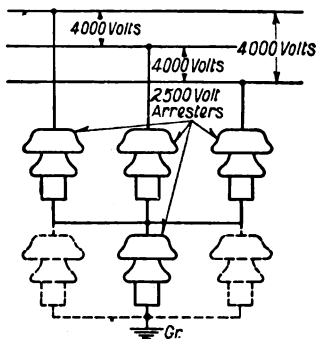


FIG. 7—MULTIPLEX CONNECTION, 4000-VOLT, THREE-PHASE, THREE-WIRE, GROUNDED OR UNGROUNDED NEUTRAL CIRCUIT  
NOTE:—For other voltages, use above connections with arresters rated at voltage to neutral. The addition of two arresters, as shown dotted, increases the protection 100 per cent.

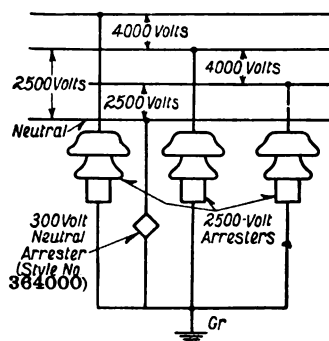


FIG. 8—4000-VOLT, THREE-PHASE, FOUR-WIRE, GROUNDED NEUTRAL CIRCUIT, WITH NEUTRAL WIRE CARRIED OUT TO DISTRIBUTION TRANSFORMERS

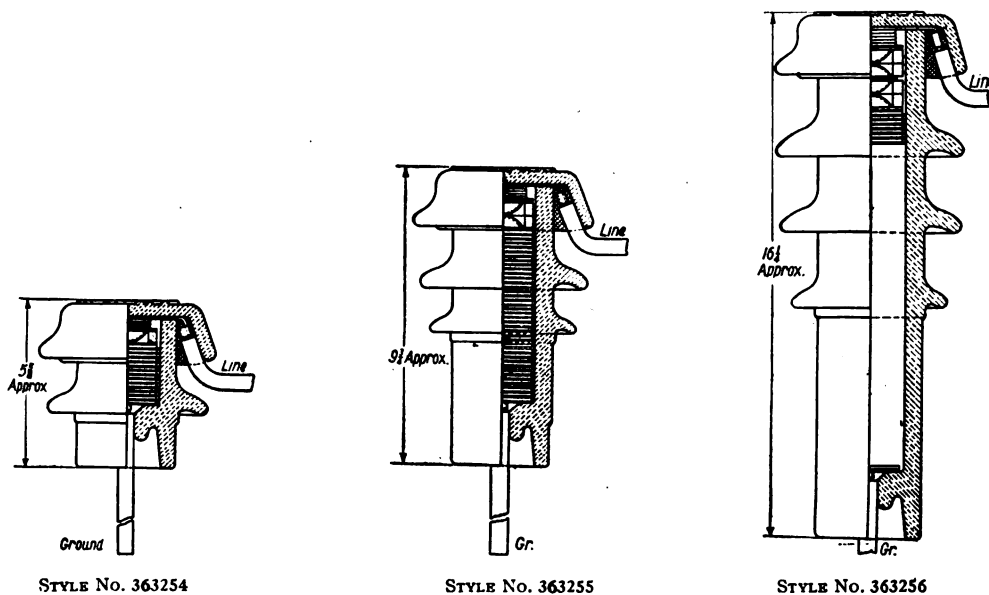


FIG.—9 SECTION OF AUTOVALVE ARRESTERS SHOWING INTERNAL CONSTRUCTION

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE LV AUTOVALVE DISTRIBUTION ARRESTERS—Continued

APPROXIMATE DIMENSIONS IN INCHES

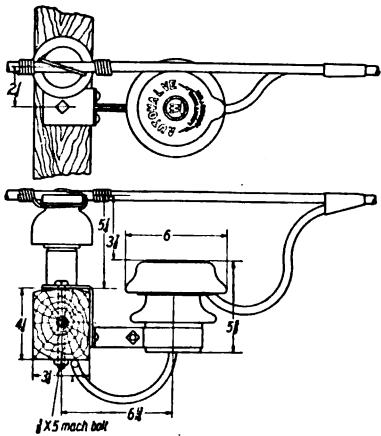


FIG. 10—SIDE AND TOP VIEWS OF 2500-VOLT ARRESTER WITH FORM T MOUNTING BRACKET

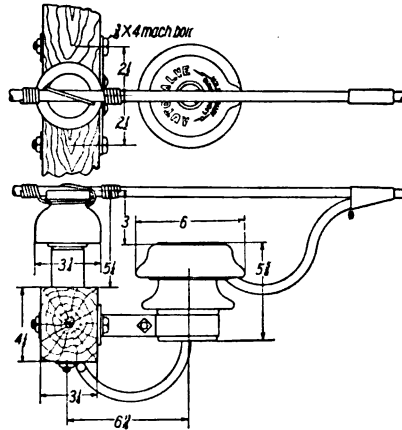


FIG. 11—SIDE AND TOP VIEWS OF 2500-VOLT ARRESTER WITH FORM H MOUNTING BRACKET

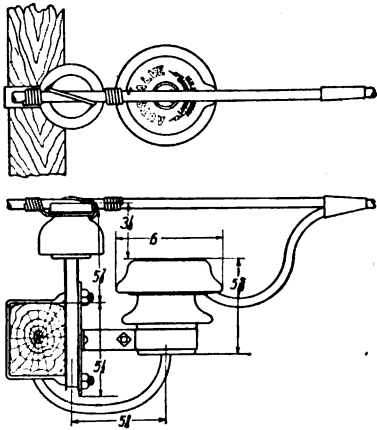


FIG. 12—SIDE AND TOP VIEWS OF 2500-VOLT ARRESTER WITH FORM C MOUNTING BRACKET AND PIERCE CLAMP PIN

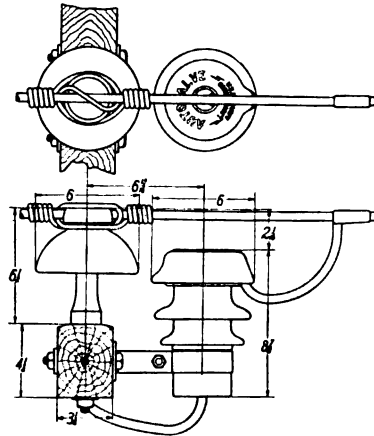


FIG. 13—SIDE AND TOP VIEWS OF 7500-VOLT ARRESTER WITH FORM H MOUNTING BRACKET

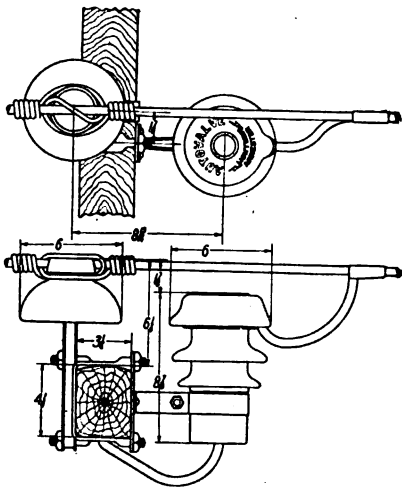


FIG. 14—SIDE AND TOP VIEWS OF 7500-VOLT ARRESTER WITH FORM C MOUNTING BRACKET AND PIERCE CLAMP PIN

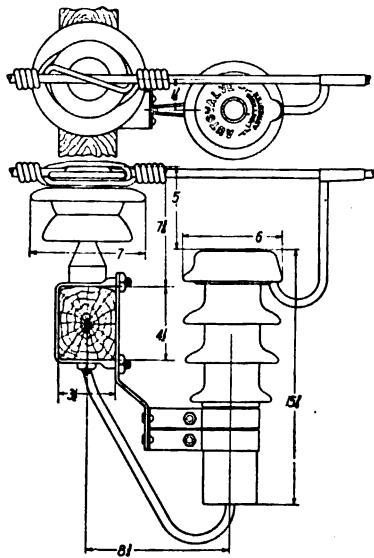


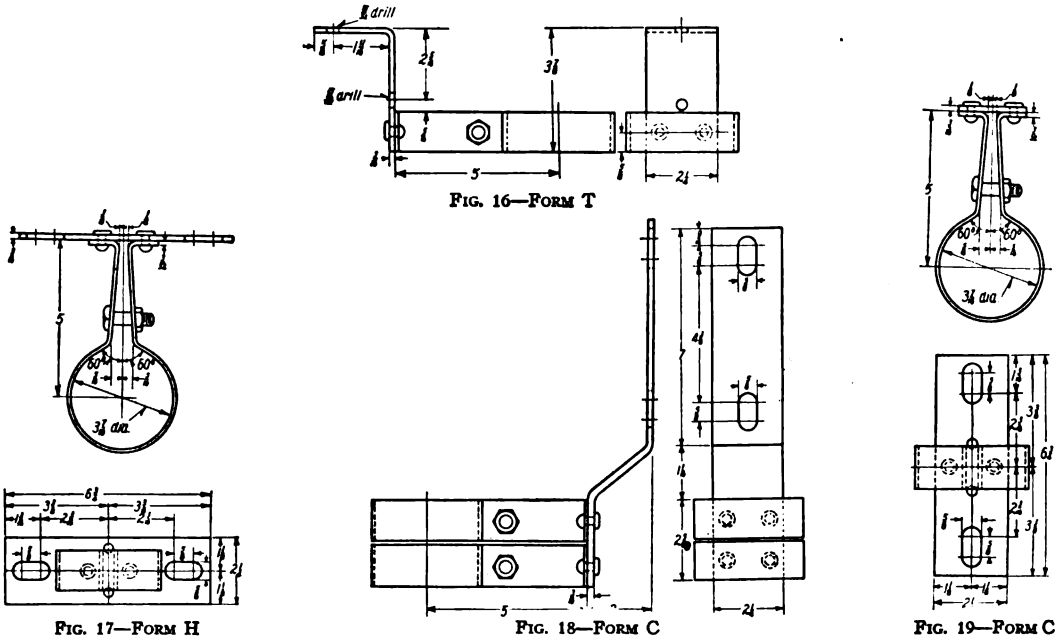
FIG. 15—SIDE AND TOP VIEWS OF 15,000-VOLT ARRESTER WITH FORM C MOUNTING BRACKET AND PIERCE CLAMP PIN

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE LV AUTOVALVE DISTRIBUTION ARRESTERS—Continued

MOUNTING BRACKETS

DIMENSIONS IN INCHES



These dimensions are for reference only. For official dimensions apply to nearest district office.

PRICES

Fig. No.	Form	Method of Mounting	Net Weight Lbs.	Style No.	List Price
16	T	Top of cross arm mounting strap, using one bolt or one lag screw.....	1 1/2	383391	\$0 60
17	H	Horizontal Strap, mounts against side of cross arm, using two bolts or two lag screws.....	1 1/2	383390	60
18	C	Clamps against the side of the cross arm, using Pierce Clamp.....	3	383392	1 20
19	C	Clamps against the side of the cross arm, using Pierce Clamp.....	1 1/2	383389	60

MULTI-GAP LIGHTNING ARRESTERS

FOR ALTERNATING-CURRENT LIGHT AND POWER CIRCUITS

TYPE MP LIGHTNING ARRESTERS

Single-Pole, for 100 to 750 Volts, Alternating or Direct Current

For description, application, price, etc., of the type MP arresters refer to pages 5 and 6 of this catalogue.



TYPE CR LIGHTNING ARRESTERS

Single-pole For 1000 to 5000 Volts, Any Frequency

For Distribution Transformers and Series Lighting Circuit Protection, Unlimited Application

Voltage	Description	Style No.	List Price
2500	Type CR Arrester, Iron Box.....	240916	\$10 70
2500	Type CR Arrester, Wood Box.....	272985	10 70
2500	Gap Unit, including Resistor Rod.....	242017	6 00
2500	Resistor Rod.....	210233	1 90
5000	Type CR Arrester, Wood Box.....	275978	15 75
5000	Gap Unit, not including Resistor Rod.....	280837	3 25
5000	Resistor Rod.....	257788	3 25

Order by Style Number

## MULTI-GAP LIGHTNING ARRESTERS—Continued

## TYPE W LIGHTNING ARRESTERS

Single-Pole for 5000 to 13,200 Volts, all Frequencies  
For Distribution Transformer Protection, Unlimited Application

Type	Voltage	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
Indoor	6600	9 1/4	21 1/4	179914	\$28 00
Outdoor	6000	10	25	201873	29 50
*Insulator				214316	3 45†

\*For use with two type W arresters in series on 13,200-volt circuits.

†Supplied without additional charge when specified on order for type W arresters in quantities of one insulator for each set of two arresters.

Order by Style Number

## TYPE LE (LOW EQUIVALENT) LIGHTNING ARRESTERS

Single-Pole, For Voltages up to 39,000 Volts

For Protection of Transformers and Station Apparatus, Limited or Unlimited Application

The type LE (Low Equivalent) arresters are of the multi-gap type and are for use on alternating-current circuits of any frequency, up to 39,000 volts of limited and unlimited capacity.

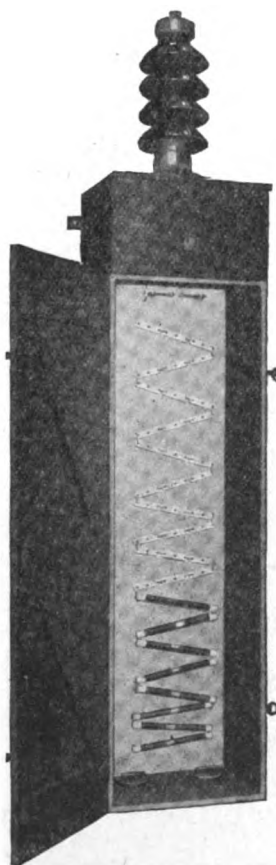
These arresters consist of series and shunt-gaps between non-arcing metal cylinders mounted in porcelain containers; also shunt or series and shunt rod resistors mounted in fuse clips. Both the gap units and the resistors are mounted on a marble base. In the outdoor form the arrester is encased in a weatherproof wooden box of good construction.

The outdoor form of this arrester provides, in the higher voltages, a high grade arrester more moderately priced than the electrolytic. In this form, therefore, it is especially applicable for protection of outdoor transformer substations.

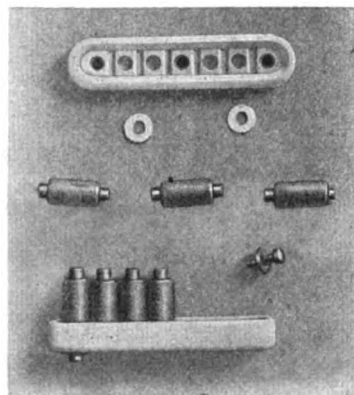
It is recommended that a disconnecting switch be supplied with each arrester, in order to easily disconnect it from the line when desired.

Style numbers and list prices include arresters complete as described, ready for mounting but do not include mounting bolts. In ordering state voltage upon which arresters are to be used.

The limited application type LE arresters are for use on circuits not exceeding 2000 to 7500 volts but limited in capacity to 2000 kilovolt-amperes in terms of normal generator capacity, except that where used on circuits connected to the secondary of transformers of not over 1000 kilovolt-amperes capacity the generator-capacity may be disregarded. The unlimited application arresters are for use on any circuit irrespective of the capacity of the equipment.



STYLE No. 263045

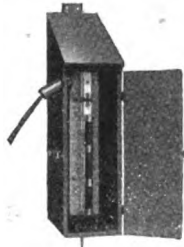


GAP UNIT DISMANTLED TO SHOW CONSTRUCTION OF THE VARIOUS PARTS

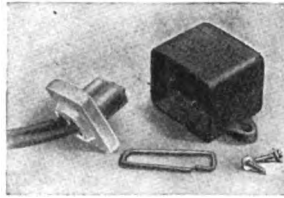
The neutral arrester Style No. 46185 consists of two non-arcing metal cylinders, with a gap between, mounted on a porcelain base, and in a weather-proof iron box. It is used as a neutral arrester on grounded neutral circuits up to 5000 volts and ungrounded circuits up to 1100 volts; for the protection of series

MULTI-GAP LIGHTNING ARRESTERS—Continued

a-c. arc lamps and incandescent lamp fixture transformers; and for the protection of transformer secondaries up to 300 volts and 200 kv-a. capacity. Type LE arresters of limited application can be used as safety spark gaps within their capacity and voltage limitations.



STYLE No. 277814



STYLE No. 46185



STYLE No. 277817

PRICES—TYPE LE ARRESTERS

Voltage	INDOOR ARRESTERS			OUTDOOR ARRESTERS		
	APPROX. WT., LBS. Boxed	Style No.	List Price	APPROX. WT., LBS. Boxed	Style No.	List Price
<b>Type LE Arresters—Limited Application</b>						
0-300†	25	262171	\$20 00	45	46185	\$ 4 15
2000-3500	27	277817	28 25	50	262067	28 00
3501-5000	30	262063	42 00	55	262054	46 00
5001-7500					277814	56 00
						1 50
						1 50
						1 50

Resistance Rod, Style No. 272822 for 2000-3500 volts.  
Resistance Rod, Style No. 277823 for 3501-5000 volts.  
Resistance Rod, Style No. 277713 for 5001-7500 volts.

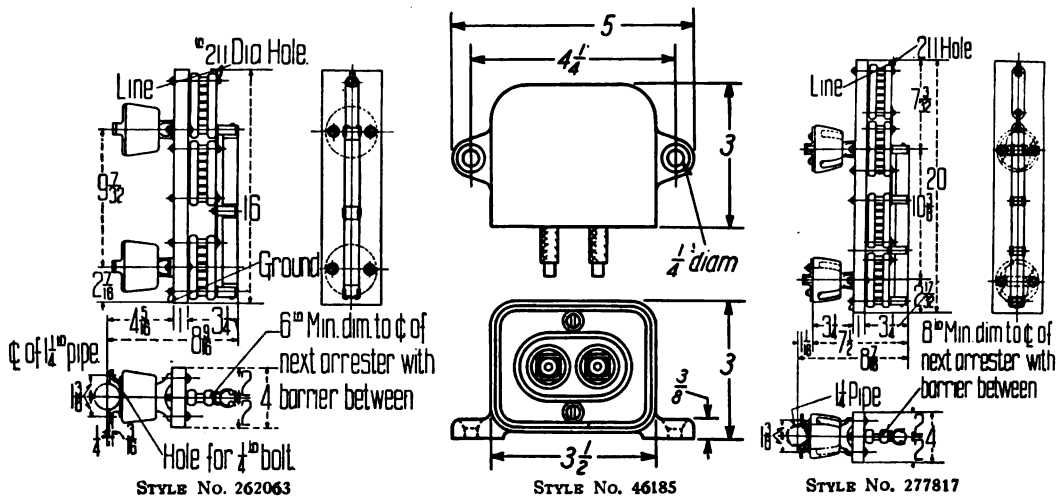
Type LE Arresters—Unlimited Application

2000-3500	150	18598	\$29 50	240	201597	\$48 00
3500-5175	160	18599	40 00	256	201598	60 00
5175-7500	175	18600	60 00	280	201599	88 50
10,000-14,500	225	18602	96 00	360	201610	155 00
19,000-27,500	375	25028	265 00	600	201603	395 00
27,500-39,000	450	25029	290 00	700	263045	645 00
						1 50
						1 80
						2 40
						2 50
						2 50
						2 00

Resistance Rod, Style No. 98062, 2000-7500 volts.  
Resistance Rod, Style No. 210610, 10,000-14,500 Volts.  
Resistance Rod, Style No. 214245, 19,000-39,000 Volts.  
Tell-Tale Papers, Form No. 5491, for Shunted Gaps, per Pad of 50.  
Tell-Tale Papers, Form No. 5492, for Series Gaps, per Pad of 50.  
Gap Unit, Style No. 9587, all Voltages and Type LE Arresters.  
†This is not a type LE arrester, but a Safety Spark Gap arrester. Maximum voltage application as a spark-gap on transformer secondary 0-1100 volts.

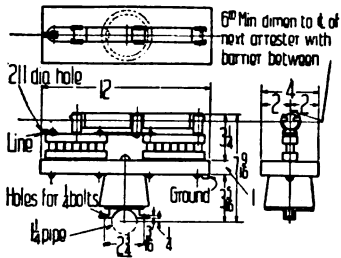
OUTLINE DIMENSIONS IN INCHES

Type LE Arresters—Limited Application

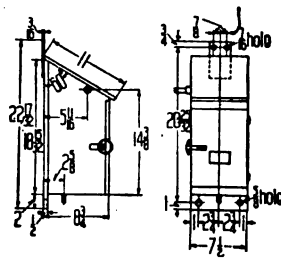


Order by Style Number

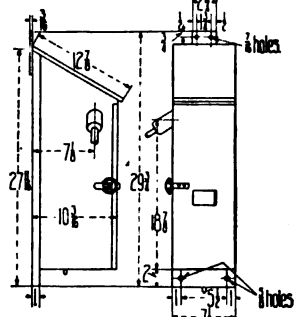
MULTI-GAP LIGHTNING ARRESTERS—Continued



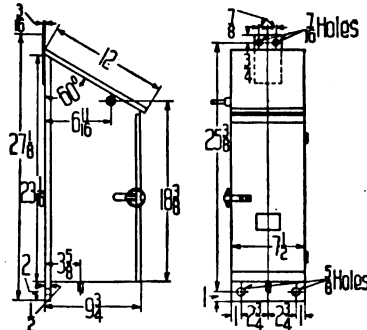
STYLE No. 262171



STYLE No. 262067



STYLE No. 262054



STYLE No. 277814

Type LE Arresters—Unlimited Application

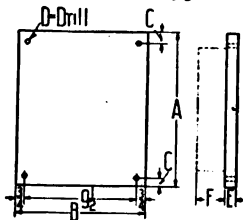


FIG. 1

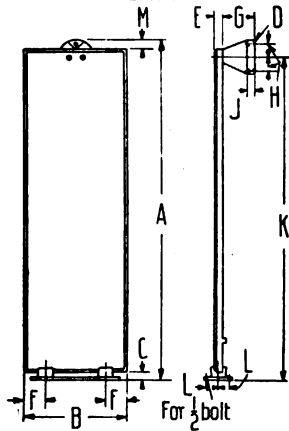


FIG. 2

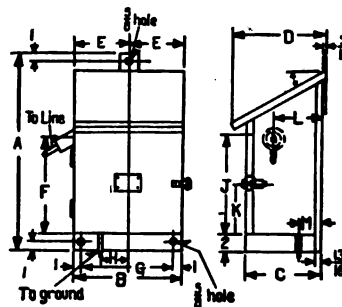


FIG. 3

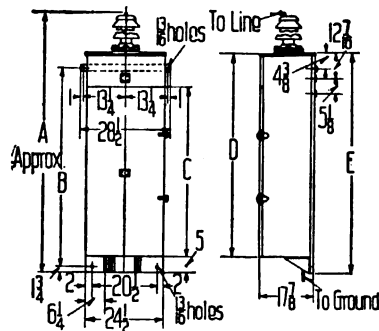


FIG. 4

Style No	DIMENSIONS IN INCHES												
	Fig.	A	B	C	D	E	F	G	H	J	K	L	M
16598	1	13	11	3/4	3/8	1	3/4	...	...	...	...	...	...
16599	1	20	8	3/4	1	1	1	2 1/4	...	...	...	...	...
16600	1	32	19	1	1 1/2	1	1	3 1/4	...	...	...	...	...
16602	2	32 3/4	12	1 1/2	1 1/2	1 1/2	6	6 1/2	2 1/2	1 1/2	29 1/2	1 1/2	1 1/2
25028	2	58 3/4	18	1 1/2	1 1/2	1 1/2	3	5 1/2	2 1/2	1 1/2	55 1/2	1 1/2	1 1/2
25029	2	89 3/4	18	1 1/2	1 1/2	1 1/2	3	12 1/2	3 1/2	1 1/2	77 1/2	1 1/2	3 1/2
201597	3	23 1/2	18	9 1/2	11	6 1/2	11 1/2	11	3 1/2	12	5	2 1/2	2 1/2
201598	3	29 3/4	11	9 1/2	11	5 1/2	17 1/4	9	2	18 1/4	9 1/2	5 1/2	2 1/2
201599	3	42	18	9 1/2	11	6 1/2	25	11	3	30	15	2 1/2	2 1/2
201601	3	44	15	13 1/2	15 1/2	7 1/2	26 1/4	13	4 1/4	29	14 1/2	3 1/2	5 1/2
201603	4	102	71 1/2	57 1/2	72	77 1/2	...	...	...	...	...	...	...
283045	4	134	100 1/2	86 1/2	101	106 1/2	...	...	...	...	...	...	...

These dimensions are for reference only. For official dimensions refer to nearest district office.



## LIGHTNING ARRESTER FITTINGS



GROUND POINT AND CAP

**Ground Plate**—This plate consists of a circular piece of cast iron, 12 inches in diameter,  $\frac{3}{4}$  inches thick with a  $\frac{3}{4}$ -inch pipe tap in the center for connecting to the arrester. The surface is increased by means of corrugations, as shown in the accompanying illustrations, to 336 square inches, affording ample contact with the earth, and capable of taking care of all discharges through the arrester.

The plate should preferably be buried at the foot of the pole so that the ground wire runs to it in a straight line from the arrester. Care should, of course, be taken to see that the earth in which the plate is buried is damp.

If the ground wire is placed within the pipe leading to the ground plate it should be soldered to a cap at the top of the pipe to eliminate the inductive effect due to the wire being surrounded by the iron.

**Ground Point and Cap**—One of the simplest and most effective methods of securing a good ground for line arresters is by means of an iron pipe with a malleable iron point having a dipped galvanized finish, and a brass cap with a lug for soldering the ground wire.

The brass cap and malleable iron point are tapped for use with  $\frac{3}{4}$ -inch pipe.

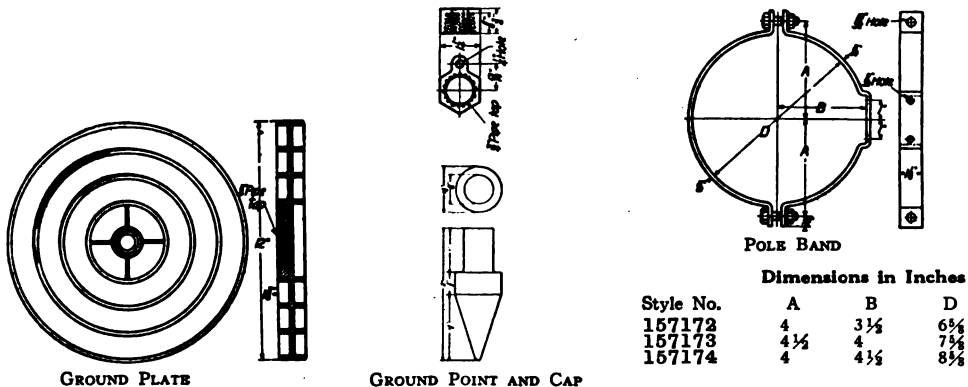
**Iron Pole Bands for MP and CR Arresters**—For affording a convenient and ready method of mounting the type MP and CR arresters on iron poles of various diameters, there are listed below three-pole band brackets. These brackets consist of two semi-circular light iron straps which are clasped around the pole and tightened by means of two bolts and nuts.

The arrester is mounted on the flattened part and secured thereto by bolts.

### PRICES

Description	APPROX. WEIGHT, LBS.		Style No.	List Price Per 100
	Net	Shipping		
Ground plate	7	13	157171	\$189 00
Brass Cap	$\frac{1}{2}$	$\frac{1}{2}$	157170	66 50
Malleable point	1	...	157169	100 00
6 $\frac{1}{2}$ -inch diameter pole band	2	2	157172	156 00
7 $\frac{1}{2}$ -inch diameter pole band	2 $\frac{1}{2}$	2 $\frac{1}{2}$	157173	158 00
8 $\frac{1}{2}$ -inch diameter pole band	2 $\frac{3}{4}$	2 $\frac{3}{4}$	157174	161 00

### APPROXIMATE DIMENSIONS



Style No.	Dimensions in Inches		
	A	B	D
157172	4	3 $\frac{1}{2}$	6 $\frac{1}{2}$
157173	4 $\frac{1}{2}$	4	7 $\frac{1}{2}$
157174	4	4 $\frac{1}{2}$	8 $\frac{1}{2}$

The dimensions given on this page are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number

## STATION ARRESTERS

### APPLICATION

The general field of application of the large capacity arresters is the protection of generating and substation equipment. There are in addition some special cases where they should be used, for example, where rotating equipment, such as induction motors or generators, is connected directly to an overhead system or where large distribution transformers are installed where lightning conditions are particularly severe or in isolated locations.

For generating and important substations all factors which bear on the application of arresters point to the use of the highest available grade of arresters. The equipment is usually terminal apparatus exposed to surges from great lengths of circuit where an individual arrester must afford all the required protection. In these stations the apparatus is of large size, expensive to repair or

replace, and in case of a failure the service may be interrupted over a considerable portion of the system. From all standpoints, it is worth while to apply the best available protection even at considerable initial cost and at a high maintenance expense.

In the case of substations of small capacity, the service conditions are just as severe as in the case of the larger stations but where they serve few or even individual users, the application of the highest grade of arresters may not be economically warranted.

Wherever rotating equipment is connected directly to an overhead line of any appreciable length, an arrester of the highest available quality should be provided since the comparatively low factor of safety of the insulation makes such apparatus particularly susceptible to injury by surge voltages.

### TYPE SV AUTOVALVE ARRESTERS

Type SV (station autovalve) arresters are large capacity arresters built on the autovalve principle, described in the section on "Some Facts About Lightning," page 2. They are applicable where the best possible protection is required, since every characteristic required for the highest degree protection is provided.

The breakdown voltage can be controlled with accuracy since this characteristic of the complete arrester depends upon a characteristic of the individual gaps which is practically constant over a considerable range of manufacturing variations. Therefore, it is practical to use a small margin between initial relief voltage and line voltage. This insures that the discharge starts before the surge voltage has arisen to a dangerous value.

The disc area has been made large in order to provide a discharge path of very low resistance, as low in fact, as that of the standard electrolytic lightning arresters. This insures that during discharge, the surge voltage which the arrester permits to be applied to the apparatus insulation does not rise to a dangerous value due to the impedance of the arrester.

Simplicity and consequent freedom from trouble are natural characteristics of this arrester. The

device is, in a sense, a spark-gap type of arrester to which the essential valve characteristics have been imparted by proper selection of electrodes and gap lengths. The autovalve is the only arrester of the valve type which is not chemical in its action. There is no deterioration of its active elements due to discharges. The natural simplicity of the spark-gap arresters and the desirable performance characteristics of the chemical-valve type arresters are, therefore, combined in the autovalve. Its simplicity and lack of need of attendance are important not only because of the economic advantage, although that is great, but also because they make applications feasible in the field, already great and rapidly growing, where attendance is infrequent or irregular.

Type SV arresters are made for indoor or outdoor service, the two types being identical, except that the units and gaps of the outdoor arresters are protected against rain. Arresters are available for standard transmission voltages except for the higher values.

Prices, weights and dimensions will be furnished upon request.

For information on SV arresters to be used on applications where the voltage exceeds 66,000, refer to the nearest District Office.

### PROTECTION

Wherever economic conditions warrant the best grade of protection (and this includes all generating stations and all but the smallest substations, as well as the rotating equipment mentioned) the type SV Autovalve or the Electrolytic arrester should be applied. When the Electrolytic arrester is used, the best protection is given by the type AL because of the lower initial relief voltage. Except in the case of cable systems, choke coils of the best avail-

able type, namely, the type D-15, should always be used.

It is desirable to protect each incoming line and, in general, this is economically feasible.

In the case of smaller stations where economic conditions do not warrant the use of the higher grade arresters, the type LV Autovalve or the type LE low equivalent arresters should be applied.

## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS

FOR ALTERNATING-CURRENT LIGHT AND POWER CIRCUITS

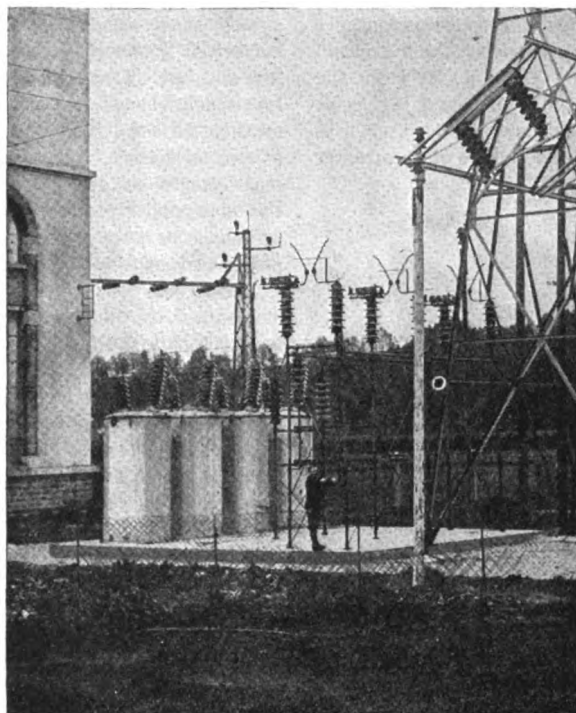


FIG. 1—TYPE AK ELECTROLYTIC LIGHTNING ARRESTER INSTALLED AT AN 88,000-VOLT STATION

The distinctive features of the Westinghouse electrolytic arrester are: **An inorganic electrolyte** that is more stable chemically, less affected by heat, and which causes less dissolution of the film between charging periods than any other electrolyte on the market; double cone-shaped aluminum tray, the area exposed to electrolyte being double that of any other arrester; trays spaced by porcelain pieces and not touching wood; ventilating duct in center of tray stack for additional circulation of oil; tank lining of bakelite micarta, impervious to moisture; charge-and-discharge resistors on all arresters; fuses included with all arresters; the use of impulse gaps on 1000 to 154,000 volt arresters and of sphere gaps on arresters, 15,001 volts and above.

**Application of Electrolytic Arresters**—All listed three-phase arresters are adapted for grounded or ungrounded neutral service. These arresters consist of four elements, one connected to each phase with the fourth element connected between the common point of the three and ground, known as a multiplex connection.

For three-phase four-wire solidly grounded neutral service a special arrester of three elements, when desired, can be supplied at a lower expense than the four-element arrester listed. These arresters are supplied with elements sufficient to stand full voltage between each phase and ground. Dimensions and price upon request.

**Arresters for outdoor service** are the same as indoor arresters except that outdoor insulators are provided on terminals. They are not provided for voltages of less than 5001. For voltages below this, the gaps cannot, with safety, be set close enough together out of doors to take advantage of the freedom of discharge of the electrolytic element. If the gaps are set too close together, they are short-circuited by rain. If arresters for less than 5001 volts must be installed out of doors, a shelter should be built for their protection.

**Application Voltage**—In applying electrolytic lightning arresters, it should be carefully borne in mind that it is not the normal operating voltage of

## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

the circuit that determines the rating of the arrester to be used. The maximum rated voltage of the arrester must be at least equal to the maximum operating voltage that may exist at any time at the point where the arrester is installed. This maximum voltage usually occurs at the time of no-load and is approximately equal to the voltage of the generator or transformer feeding the line upon which the arrester is installed. On long transmission lines of considerable electrostatic capacity, the maximum voltage at the end of the line farthest from the generator or transformer may be even higher at times of no load. Where this condition is known to exist and the **maximum rated voltage of an arrester**

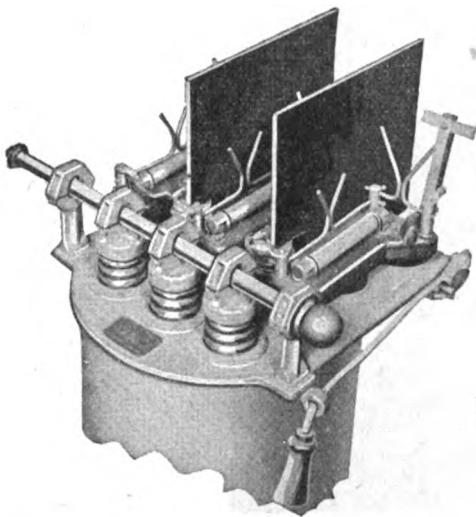


FIG. 2—HORN GAPS AND TRANSFER-SWITCH STRUCTURE FOR 1000 TO 7500-VOLT, INDOOR MOUNTING, TYPE AK ARRESTERS

is very near the maximum line voltage, it is recommended that an arrester for the next higher voltage be installed.

It is the practice of some operating companies to purchase arresters for the ultimate voltage of their lines and then operate the arresters at the present line voltage which is materially lower than the ultimate. When the foregoing condition exists it is recommended that (1st) when the lines will be changed to the higher voltage within one year from date of delivery, the higher voltage arrester be purchased and used complete; and (2nd), when the lines will not be changed to the higher voltage within one year from date of delivery, the higher voltage arrester with trays omitted to make the arrester directly applicable at the service voltage be purchased complete. Under the second condition of purchase the necessary additional trays can be inserted for use on full voltage when wanted.

All test guarantees are based on the normal voltage but the arresters may be used on voltages up to the maximum.

In the 3000, 5000, 7500, 15,000, 25,000, 37,000, 50,000 and 73,000-volt maximum arresters, the test guarantees are based upon 2300, 4600, 6900, 13,800, 23,000, 34,500, 44,000, and 66,000 volts respectively.

**General Construction**—The electrolytic lightning arrester consists of a system of nested aluminum double cone-shaped trays (supported on porcelain and secured in frames of treated wood) arranged in a steel tank. The system of trays is electrically connected between line and ground, and between line and line. These trays contain a liquid electrolyte which, when the arrester is charged, forms a film on their surfaces. This film prevents flow of current at normal voltages but forms a free path for abnormal voltages or static discharges. Upon cessation of the abnormal stress, the film regains its original resistance practically instantaneously and prevents power current from following the discharge.

The types of electrolytic arresters offered are determined by the characteristics of the gaps used, in fact, for the same voltage applications the various types of electrolytic arresters are practically the same except for the gaps. The type AK arresters use plain horn gap and sphere (horn) gap. The type AL Arresters use the impulse gap. **To date there is not an arrester on the market which approaches the type AL arrester in the protection given.**

**Horn and Sphere Gaps**—The sphere gap has shorter dielectric spark lag than the horn gap, that is, it has a greater speed of discharge. The use of sphere gaps on the high voltage arresters, therefore, considerably increases the protection afforded the apparatus. On the lower voltage arresters, the rods forming the horn gaps are of such a diameter that they have the same effect as sphere gaps, that is, the gap is so small in proportion to the diameter of the horn that the effect is the same as if sphere gaps were used.

It is to be noted that sphere gaps have horn extensions, rising above the spheres, to assist the arc to rise, and thus be quickly extinguished.

On all electrolytic arresters for alternating-current circuits the horns or spheres when in the operating position are on a straight line. The charging operation is performed by rotating one horn or sphere with respect to the other one until it is offset sufficiently for one or the other of the horns or spheres of each gap to come in contact with a phosphor-bronze strip attached to the support of the opposite horn or sphere making up the gap. The gap may be swung out to the widest extent on open position and used as a disconnecting switch.

On indoor arresters up to 7500 volts, the horns and charging resistances are mounted on a porcelain base supported on the tank cover. The fuses are placed on the line side of the arrester and serve as a disconnecting switch when the fuses are removed.

On indoor arresters for voltages 7501 to 15,000 volts the horns are held in their normal operating position by stops located on the horizontal bar

## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

which connects and operates, as a unit, the several movable horns. The stops on this horizontal bar may be disengaged by rotating the bar which is normally held in position by gravity acting through the combination of a weight and the operating handle. When the stops are disengaged the movable horns may be pushed to the left by means of the handle into the charging position, to the right into the open position, or into the intermediate or operating position. When the operating handle is released in either the charging or open positions, gravity again returns the stops to the engaged or normal position, and holds the gaps in that position.

On all indoor arresters for voltages above 15,000 and on all outdoor arresters the gaps are operated as described above, with the exceptions noted below. The horizontal bar for operating the gaps instead of being actuated by a handle is actuated by a rod and lever system. At the right hand end of the supporting framework a horizontal bar or lever which moves over a plate, with operating and open positions indicated, is placed at a convenient height for handling. The horizontal lever is held in either the operating or open position by a pin arrangement, and is connected to the horizontal bar operating the gaps by a vertical rod. The charging operation is performed by pushing the operating horizontal lever beyond the normal operating position, thus permitting the short-circuiting clips to make contact across the gap.

The adjustment of the gap setting is obtained by placing the gap in the operating position, loosening the set screws, which hold horn or sphere in position, and moving the horn or sphere either forward or backward until the desired setting is obtained.

All arresters for voltages above 73,000 have the same design of gap structure and transfer switch irrespective of the differences in the shape of tanks or the mounting of trays.

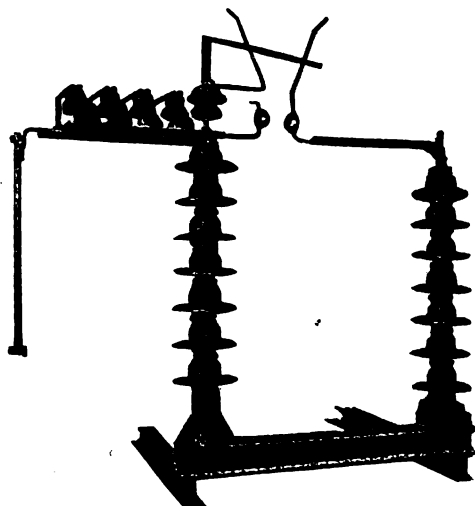


FIG. 3—SHOP ASSEMBLY OF A 110,000-VOLT SPHERE GAP

Horn and sphere gap structures for indoor arresters for voltages up to 7500 are supported by the arrester tank; for indoor arresters for voltages of 7500 to 15,000 and outdoor arresters for voltages up

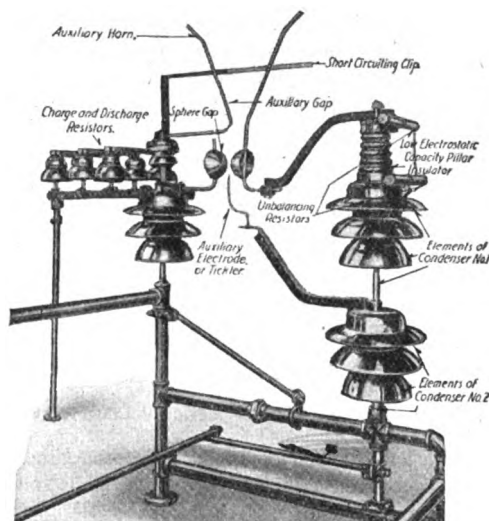


FIG. 4—TYPICAL IMPULSE GAP

to 7,500 they are arranged for wall mounting. Horn and sphere gap structures are self-supporting on indoor arresters of 15,001 to 25,000 volts and outdoor arresters of 7501 to 69,300 volts. The vertical pipe or structural steel for horn and sphere gap structures is not furnished on indoor arresters for voltages above 25,000 and outdoor arresters for voltages above 69,300.

The supporting structure for the transfer switch and the "footstep bearing" structure for the horn or sphere gap short-circuiting device is furnished on all arresters.

Type AK arresters equipped with sphere gaps are listed herein for voltages of 15,001 volts and above. Arresters with horn gaps are listed up to and including 15,000 volts. The gaps are so arranged that they are readily adjustable for any line voltage, and are provided with charge-and-discharge resistors on all arresters. Suitable mounting supports carry the sphere or horn gaps and their accessories.

**Impulse Gaps**—The type AL impulse gaps for lightning arresters are recommended for use in connection with lightning arresters which protect stations of large capacity operating at 1,000 volts and higher. The impulse gap excels every other known gap in assisting arresters to give protection from lightning and other high-frequency or high-voltage disturbances.

The impulse gaps, as listed herein, are for use in connection with electrolytic or other three-phase (grounded or ungrounded-neutral-circuit) lightning arresters now in service.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

**Distinctive Features**—The impulse gap protects the insulation against high-frequency or steep wave-front surges of high potential at a lower voltage than does any other known gap.

**Operation of Impulse Gap**—Plain horn gaps, spaced at greater than their electrode diameters have considerable time-lag, allowing a high-frequency surge to rise to a much higher voltage than

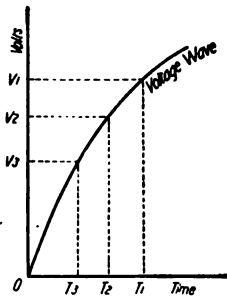


FIG. 5—TYPICAL CURVE OF A HIGH-VOLTAGE WAVE

would a low-frequency surge before discharging and giving protection. The development of the sphere gap partly prevents this situation by eliminating the time lag so that all frequencies are discharged at the same voltage. The new impulse gap has a negative time lag, that is the higher the frequency the lower the voltage at which the gap discharges. Thus the impulse gap automatically selects the dangerous surges and gives protection more quickly than any other known form of gap.

The impulse gap not only incorporates all of the virtues of the horn gap and the high-speed sphere gap but also possesses the property of selecting high-frequency or steep-wave-front surges and discharging them at a lower voltage than the normal voltage setting of the gap. It should be particularly noted that the impulse gap is the only device which will protect insulation against a steep-wave-front surge of reverse potential, Case C, Fig. 7. The high-frequency discharge voltage may be as low as two-

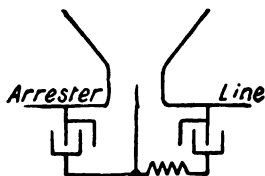


FIG. 6—SCHEMATIC DIAGRAM OF IMPULSE GAP

thirds, or even one-third, of the normal-frequency value. It is, therefore, possible to use a gap setting that will permit of the desired degree of protection against dangerous surges while not permitting too frequent discharging on minor surges at normal frequency.

The high speed of the sphere gap as compared with the horn gap is due to the elimination of the time required to build up a sphere of equal potential

surface at the discharge part of the horn gap. The sphere of the sphere gap provides at once for this sphere of equal potential surface and practically eliminates corona and reduces field distortions when the gap is set equal to, or less than, the sphere diameter. By the use of the sphere gap the voltage to ground, or the break-down voltage, at any frequency does not materially exceed the 60-cycle discharge voltage of the gap. However, the sphere gap does not give the desired protection against steep-wave-front, or high-frequency surges, due to its inability to discharge these disturbances at lower voltage than the normal frequency setting of the gap. It is necessary to set all arrester gaps for a sufficiently high normal frequency break-down voltage so that they will not discharge too frequently on comparatively harmless low-frequency switching surges. With the impulse gap, however, the advantages of this high normal-frequency setting of the gap can be had without the corresponding disadvantage of reduced protection, since the high-frequency break-down value of the gap is much lower. This is because high-frequency discharges start from the auxiliary electrode and have only one-half of the gap to jump. The latter electrode, also, is so shaped that although the gap is one-half of the main gap, the break-down voltage is only

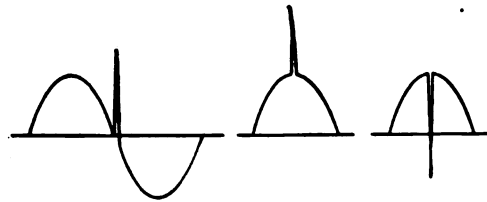


FIG. 7—IMPULSE VOLTAGE SUPERIMPOSED ON 60-CYCLE WAVE

about one-fourth as great. that is to say, high-frequency surges not only are not delayed in discharging, as with plain horns, by the need of building up a static field; but instead, discharge at a voltage even lower than the normal value of the main gap, since they automatically select the auxiliary gap of much lower voltage break-down.

Fig. 5 illustrates this graphically.  $V_2 T_2$  represents the point and time of break-down of a properly designed sphere gap which has no time lag.  $V_1 T_1$  shows the delay resulting from the time lag of an ordinary horn gap and the consequent greater rise of voltage before the discharge takes place.  $V_3 T_3$ , on the other hand, shows the earlier discharge and the quicker and better protection resulting from the lower voltage break-down of the impulse gap due to its selective property.

The impulse gap uses a circuit (see Fig. 6) that at normal frequency, is balanced as to voltage, but becomes unbalanced and starts a discharge in the case of any high-frequency surge. At normal frequency there is no difference of potential between

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

the mid-point of the condensers and the auxiliary electrode between the auxiliary horn or sphere gap. A high frequency, however, passes freely through the condensers and piles up its full voltage across

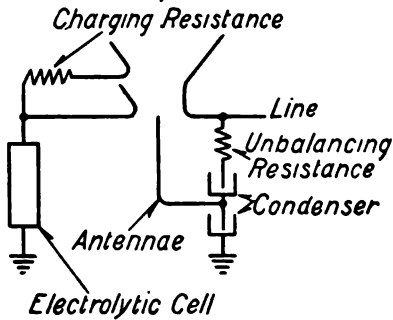


FIG. 8—DIAGRAM FOR COMMERCIAL FORM OF IMPULSE GAP ARRESTERS

the resistance, that is, across approximately one-half of the total gap. This gap, therefore, breaks down, resulting in the total voltage being impressed on the remainder of the main gap, which breaks down in turn, dissipating the disturbance to ground. The breakdown of each half of the gap is facilitated by the fact that the auxiliary electrode is small in

size (having needle gap characteristics) so that the discharge voltage of each part of the gap is about one-quarter, rather than one-half, of that of the total gap between the spheres. It should be especially noted that the danger to apparatus from steep, wave-front surges, particularly of reverse potential, may be out of proportion to their actual magnitude, due to the inductance of apparatus, which not only produces a high voltage across the first few turns of the winding of any apparatus, but also a much higher voltage to ground than the normal voltage of the impulse, due to the addition of induced or reflected voltage to the normal voltage of the impulse. If the apparatus is to be protected with a gap and lightning arrester, the gap should be one that will select and discharge the high frequency disturbances at a voltage lower than the normal voltage of the gap. The impulse gap accomplishes the desired result.

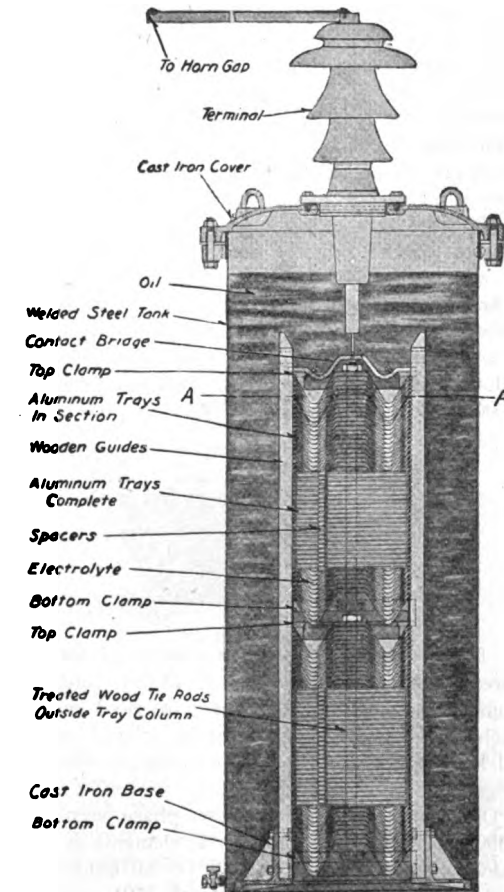


FIG. 9—SECTION OF TYPICAL TYPE AK ELECTROLYTIC LIGHTNING ARRESTER

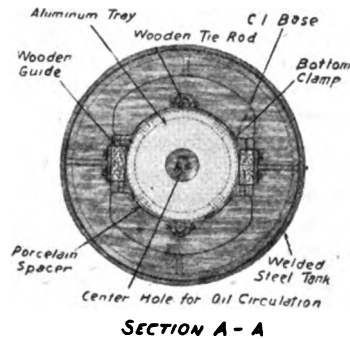


FIG. 10—CROSS-SECTION THROUGH TANK AT A-A

The necessity of selective action in the gap is emphasized by the following possible combinations (see Fig. 7) of the impulse and line voltage. (Assume that an ordinary sphere gap to ground is set to discharge at twice the line voltage.)

**Case A**—The voltage of the line does not affect the action of the impulse, and the impulse must reach twice the line voltage before the gap protecting the apparatus will discharge.

**Case B**—The voltage of the impulse must reach only the same voltage as that of the line, before the gap discharges.

**Case C**—The voltage must have a value three times the line voltage before the gap discharges. In this case, it is to be noted that conditions are such that the high-voltage stress is present not only to ground, but also between turns of windings of apparatus. Adequate protection against this condition demands the use of a gap which is very sensitive to steep-wave-front surges. If the impulse is oscillating the second half cycle may cause a discharge, but the time for protection against the destructive effect of the first half cycle will have passed. It is to be noted that with the impulse gap, the discharge begins at a lower voltage than with a sphere gap, and hence, operates more quickly than any sphere gap.

## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

**Construction**—The impulse gap consists of standard porcelain insulators (some of which are used as condensers), unbalancing resistor, auxiliary electrode or tickler, a sphere gap, an auxiliary horn gap, a short circuiting clip, charge-and-discharge resistors, and a supporting framework.

Impulse gap structures for indoor arresters for voltages of 10,000 to 25,000 and for outdoor arresters of 10,000 to 69,300 are self-supporting. The vertical pipe or structural steel for impulse gap structures is not furnished on indoor arresters for voltages above 25,000 nor outdoor arresters for voltages above 73,000. The "footstep bearing" structure for the impulse gap short-circuiting device is furnished on all arresters up to 73,000 volts. Above that voltage a modified ball bearing is used. This short-circuiting device works in a manner similar to the device furnished with the type AK arresters. When the type AL impulse gaps are supplied for use in connection with arresters already installed, the framework is equipped with feet, which can be mounted upon an existing structure if the purchaser supplies inverted feet or other standard pipe connections and fittings.

**Arresters for outdoor service** are furnished complete with copper tubing for wiring for voltages from 15,001 to 69,300.

As the indoor installations of lightning arresters vary greatly in detail, it is not desirable to provide copper tubing for wiring the arresters complete.

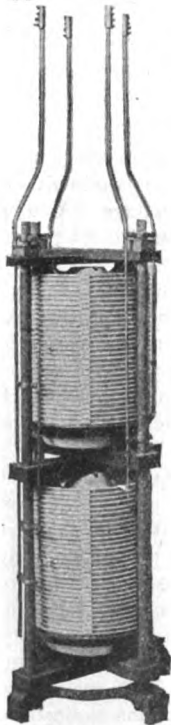


FIG. 11  
STRUCTURE USED FOR  
VOLTAGES UP TO 7500  
This shows aluminum  
trays nested in wooden  
supporting frame for a  
7500-volt ungrounded  
neutral arrester.

Copper tubing, therefore, is listed from which parts may be selected for wiring the arrester after the layout has been decided.

**Charge and Discharge Resistance**—All type AK and type AL arresters include a charge-and-discharge resistance connected between the main horn, sphere or impulse gap and the arrester proper. These resistance units consist of rod resistors. The resistor is of a composition which possesses the quality of remaining practically uniform under all conditions of service.

In the operation of charging, the normal generator current takes the resistance path, thus limiting the charging current to a low value and damping out any oscillations that might result from charging, due to inductance and capacity of the line and arrester.

**Fuses**—It is often desirable to set the gaps so that they will discharge in the event of a ground occurring on one leg.

To prevent such a discharge, which might be heavy, from continuing indefinitely with injury to the arrester, fuses are inserted which protect the arrester but in no way reduce its effectiveness. The fuses of 10-amperes capacity are on the arrester side of the gaps and serve as disconnecting switches for the arrester tanks.

**Transfer Switch**—On each occasion of "charging" arresters to rebuild their films, after once bridging the gaps the leads connecting the two middle legs or elements to the ground pipe and to the center fuse respectively, should be interchanged and the gaps again bridged. Each of the two middle

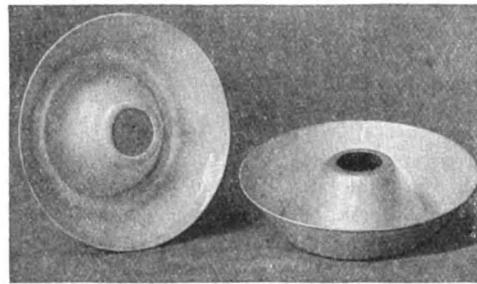


FIG. 12—ALUMINUM TRAY FOR ELECTROLYTIC ARRESTER  
(STYLE NO. 229147)

units serves alternately as the ground leg until the next charging period. Transfer switches are provided which, when thrown, affect this interchange of connections. The supporting structure for the transfer switch is furnished on all arresters.

**The tanks** are of sheet steel with all joints welded. Every precaution is taken to guard against the possibility of oil leakage. Tanks for arresters rated above 25,000 volts have an insulating "chimney" lining of mica, spaced from the tank surface to facilitate the circulation of oil and increase the insulation.

**Arrangement of Tanks**—On indoor arresters for three-phase circuits up to 7500 volts, the electrolytic elements are contained in one grounded tank. On indoor arresters for three-phase circuits for 7501 to 15,000 volts, two grounded tanks are used. On

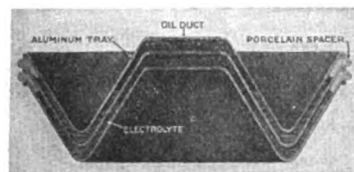


FIG. 13—CROSS-SECTION OF TRAYS SHOWING SPACES  
three-phase indoor arresters of 15,001 volts and higher, four ungrounded tanks are used one for each phase leg of the system and a ground leg. On all listed single-phase and two-phase arresters one ungrounded tank is used.

On outdoor arresters for three-phase circuits for 7500-volt service the electrolytic elements are contained in one grounded tank. On all outdoor arresters for three-phase circuits of 7501 volts and above either four ungrounded tanks or four grounded



## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

tanks are used, one for each phase leg of the system and a ground leg as indicated in the price tables. Where grounded tanks are not specified it is understood that ungrounded tanks are to be used.

The treated aluminum trays are double cone (annular) shaped thus providing a larger area exposed to the electrolyte than in any other shape of tray in general use.

This gives proportionately greater freedom of discharge. Another advantage of the double cone



FIG. 14—PORCELAIN TRAY SPACER

(annular) shape is that it provides an opening through the center of each stack of trays for the circulation of the cooling oil where it is most needed

The trays are separated from each other by porcelain spacers arranged ninety degrees ( $90^\circ$ ) apart around the edge of the tray insuring positive separation and ample space between trays for the escape of such gases as are formed during a heavy discharge. The porcelain being an inorganic material and not of vegetable origin, offers the least possibility of carbonized paths bridging or short-

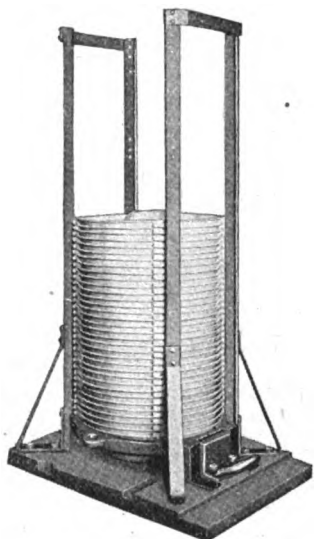


FIG. 15—JIG FOR ASSEMBLING TRAYS

circuiting the trays. The porcelain spacers inherently vary slightly in thickness but this does not affect the operation of the arrester because the resistance of the cell resides primarily in the film on the tray and only slightly in the electrolyte.

The trays are thoroughly treated chemically and electrically before leaving the factory and are shipped with the film already built up, thus making it easy to place the arrester in service without initial charging.

Tray elements or units for arresters of 46,201 volts and above are assembled in sections. Each section is contained in a frame which slides in guides to its position in the tank. Elements for voltages below 46,201 are built as a unit to fit the tanks.

**Electrolyte**—Type D electrolyte is an inorganic solution and is more stable chemically and more satisfactory in general than any electrolyte previously available. It will permit operation of the arresters at temperatures as high as 135 degrees Fahrenheit.

The films on the surfaces of the trays gradually dissolve and require periodical "charging" to keep the arrester in operating condition. Daily charging is recommended as best practice, but longer periods are practicable depending on the condition of arresters and surrounding temperature. Charging is accomplished by bridging the horn gaps for a few moments; this impresses line voltage on the arrester and rebuilds the films.

**Type D electrolyte** is furnished in powder or dry form to be mixed with distilled water before using. **Liquid electrolyte will be furnished only when specially required** due to difficulty experienced by the purchaser in procuring a supply of pure distilled water or in mixing the electrolyte so as to preserve its chemical purity.



FIG. 16—MEASURING CUP (200 C. C.) FOR FILLING TRAYS. STYLE NO. 125412

**Instructions for making liquid electrolyte** from dry electrolyte are sent with each shipment of dry electrolyte on Instruction Label, No. 947. A copy of this label will be sent upon request.

The **FX electrolyte** requires charging of the arrester once every seven (7) days instead of daily as in the case of the type D electrolyte. The FX electrolyte is brought out for use with electrolytic arresters so located that they cannot receive daily charging, i. e., at automatic substations, isolated transformer stations etc. These stations usually receive weekly inspection and the charging of the arrester can be made a part of the routine of each inspection. The FX electrolyte supplied only in liquid form, is of a slightly acid nature and is shipped in glass carboys to preserve its chemical purity.

## TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

A measuring cup is furnished with each arrester outfit for filling the trays with electrolyte.

**Oil**—The trays, filled with electrolyte, are completely immersed in transformer oil in the tanks. As the oil is lighter it does not mix with the electrolyte. The oil provides for insulation and cooling and prevents evaporation of electrolyte. The volume and circulation of oil in the tank which is nearly filled, is great enough to absorb the heat due to a continuous discharge for a long period.

**Complete directions** for the installation and maintenance of electrolytic lightning arresters are contained in Instruction Book 5127. A copy will be sent upon request.

When ordering or requesting information on **special electrolytic lightning arresters**, the following data should be given in every case:

- (1) Rated voltage of circuit, phases, frequency.
- (2) What is maximum operating voltage at power station?
- (3) Is any part to be mounted outdoors?
- (4) Is the neutral of the system grounded directly or through a low or high resistance?
- (5) Is any special construction desired to fit local surroundings?
- (6) Is it expected that the operating voltage will be increased at a later date?
- (7) Remarks.

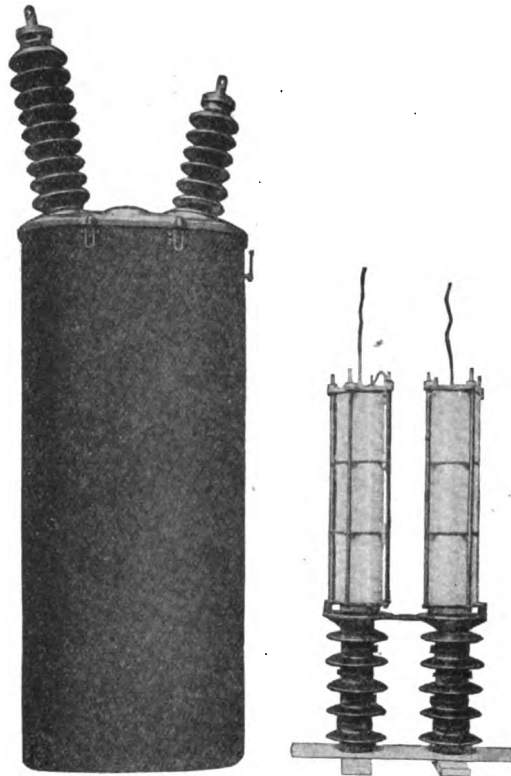


FIG. 17—TYPE OF PHASE LEG FOR 69,301 TO 138,600 VOLT ELECTROLYTIC LIGHTNING ARRESTER—(BARRIER NOT SHOWN.)

Elliptical tank with two terminals, tray structure in two columns, tray structure insulated from tanks; tanks may be mounted on any foundation and solidly grounded, thus giving increased protection to operator.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

PRICES—TYPE AK LIGHTNING ARRESTERS

Style number and list price include arrester with gaps as described complete with necessary oil and electrolyte and with charge-and-discharge resistor. Pipe supports for horn and sphere gap structures

are included up to 25,000 volts indoor and 73,000 volts outdoor and are not included above these voltages.

Normal	VOLTAGE			No. of tanks	Gal. U. S. Elec-trolyte	Gal. U. S. Oil	WEIGHT IN POUNDS				Style No.	List Price
	Minimum	Maximum					Net Erected Inc. Oil and Electrolyte	APPROXIMATE SHIPPING—Complete Elec-trolyte and in Carboys		Oil		
<b>For Three-Phase Grounded or Ungrounded Neutral Circuits</b>												
<b>Indoor Arresters With Horn Gaps**</b>												
.....	1000	3000	1	1 3/4	38	620	1050	54	348	292786	\$336 00	
.....	3001	5000	1	3	46	700	1140	62	530	292787	376 00	
.....	5001	7500	1	4 1/2	55	790	1320	72	496	292788	423 00	
.....	7501	15000	2	7 3/4	92	1295	2265	134	927	272967	810 00	
<b>Indoor Arresters With Sphere Gaps</b>												
.....	15001	25000	4	13 1/2	138	2420	3190	220	1280	306369	1150 00	
.....	25001	37000	4	22	192	3200	5220	312	1750	306370	1592 00	
44000	37001	46200	4	25	203	4080	6400	330	1845	289642	2191 00	
.....	46201	50000	4	27	211	4162	6600	355	1900	280845	2207 00	
66000	46201	69300	4	38	454	4270	10000	597	4160	289641	3374 00	
.....	69301	73000	4	40	465	7620	10240	617	4295	280847	3418 00	
<b>Outdoor Arresters With Horn Gaps**</b>												
.....	5000	7500	4	4 1/2	55	800	1400	72	496	266821	771 00	
.....	7501	15000	4	7 3/4	102	2025	3090	134	817	306371	1012 00	
<b>Outdoor Arresters With Sphere Gaps</b>												
.....	15001	25000	4	13 1/2	138	2400	3220	220	1270	306372	1515 00	
.....	25001	37000	4	22	192	3294	5370	312	1740	306373	2061 00	
44000	37001	46200	4	25	203	4085	6480	330	1830	289639	2884 00	
.....	46201	50000	4	27	211	4475	6700	355	1900	231430	2973 00	
66000	46201	69300	4	38	454	8090	10185	597	4095	289640	4301 00	
.....	69301	73000	4	40	465	8370	10390	617	4295	231434	4370 00	
88000	69301	92400	4	55	1065	19669	22640	785	9540	*315619	8505 00	
88000	69301	92400	4	55	3580	44065	54365	785	29990	*315620	12292 00	
110000	92401	115500	4	64	1280	21995	25675	955	11750	*315621	9315 00	
110000	92401	115500	4	64	3950	47495	61870	955	34000	*315622	14037 00	
132000	115501	138600	4	77	5850	68100	81940	1283	50000	*315623	17553 00	
154000	138601	161700	4	84	6144	70000	88525	1500	53000	*315624	20412 00	
<b>For Two-Phase Four-Wire Circuits</b>												
<b>Indoor Arresters With Horn Gaps</b>												
.....	1000	3000	1	1 3/4	40	620	1110	54	348	266740	422 00	
.....	5000	7500	1	4 1/2	58	790	1382	72	496	266743	543 00	
<b>For Two-Phase Three-Wire Circuits</b>												
<b>Indoor Arresters With Horn Gaps</b>												
.....	1000	3000	1	1 3/4	39	557	1025	54	340	266746	324 00	
.....	5000	7500	1	4 1/2	52	720	1300	72	480	266749	405 00	
<b>For Single-Phase Ungrounded Neutral Circuits</b>												
<b>Indoor Arresters With Horn Gaps</b>												
.....	1000	3000	1	1 3/4	34	550	975	42	320	266752	297 00	
.....	5001	7500	1	3	46	700	1280	56	475	266755	385 00	
.....	7501	15000	1	6	66	940	1800	80	705	266757	492 00	

\*Round tanks, tray structure in one column, tanks mounted on insulated platform.  
 †Elliptical tanks with two terminals, tray structure in two columns, tray structure insulated from tanks, tanks may be mounted on any foundation and solidly grounded, thus giving increased protection to operator.  
 \*\*Arresters for voltages below 15,001 have horn gaps. The diameter of the rod used for making the horns of the gap, is so large with reference to the gap that the result obtained is practically the same as though sphere gaps were used.

Type AK Sphere Gaps—To Replace Horn Gaps

Type AK arresters as formerly supplied were equipped with horn gaps for indoor and outdoor service above 15,000 volts. As some users may desire to equip their arresters with sphere gaps, sphere gaps for replacing horn gaps are listed below.

The style numbers include a horn complete with sphere.

Note—Two horns with spheres are required for one complete gap or pole. The sphere gaps as furnished are interchangeable with the horn gaps.

Arresters for voltages below 15,001 have horn gaps. The diameter of the rod used for making the horns of the gap is so large with reference to the gap that the result obtained is practically the same as though sphere gaps were used.

Indoor and Outdoor Mounting

Voltage of Arrester	Number Required Per Arrester	Style Number of Sphere Gap	List Price Each
15001 to 37000	6	272702	\$ 6 90
37001 to 73000	6	272705	13 40
73001 to 115500	6	272706	15 10

Order by Style Number

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

PRICES—TYPE AL ELECTROLYTIC LIGHTNING ARRESTERS

Construction and Description—The type AL electrolytic lightning arrester is the same in construction as the type AK electrolytic lightning arrester except that in place of sphere gaps or horn gaps the type AL impulse gap described in the foregoing is used.

Style number and list price include arrester with type AL impulse gaps as described, complete with necessary oil, electrolyte, with charge-and-discharge resistor and unbalancing resistor.

The supports for the gap structures are included up to 25,000 volts indoor and 73,000 volts outdoor and are not included above these voltages.

VOLTAGE			No. of Tanks	Gal. (U. S.) Elec-trolyte	WEIGHT IN POUNDS					Style No.	List Price
Normal	Minimum	Maximum			Gal. (U. S.) Oil	Net Erected Inc. Oil and Electrolyte	Complete With Oil and Electrolyte	Elec-trolyte in Carboys	Oil		
<b>For Three-Phase Grounded, or Ungrounded-Neutral Circuits</b>											
<b>Indoor Arresters With Impulse Gap</b>											
.....	1000	3000	1	1 3/4	38	700	1040	54	333	.....	\$ 502 00
.....	3001	5000	1	3	46	800	1230	62	415	.....	624 00
.....	5001	7400	1	4 1/2	55	860	1300	72	485	.....	729 00
.....	10000	15000	4	8 1/2	92	1450	2400	130	850	282247	1134 00
.....	15001	25000	4	13 1/2	138	2590	4090	220	1277	306384	1498 50
.....	25001	37000	4	20	192	3096	4835	308	1685	306385	1980 00
44000	37001	46200	4	25	203	4155	6315	340	1775	289635	2652 75
.....	46201	50000	4	27	211	4350	6600	370	1910	282051	2689 00
66000	46201	69300	4	38	454	7600	10100	550	4075	289636	3859 50
.....	69301	73000	4	40	465	7995	11320	580	4295	282042	3904 00
<b>Outdoor Arresters With Impulse Gap</b>											
.....	5001	7500	1	4 1/2	55	935	1375	6	485	.....	778 00
.....	10000	15000	4	8 1/2	102	1560	2550	130	1090	306386	1340 50
.....	15001	25000	4	13 1/2	138	2630	4190	220	1277	306387	1863 00
.....	25001	37000	4	20	192	3112	5035	308	1685	306388	2430 00
44000	37001	46200	4	25	203	4435	6315	340	1775	289637	3345 00
.....	46201	50000	4	27	211	4500	6820	370	1910	282050	3434 00
66000	46201	69300	4	38	454	7990	10125	550	4100	289638	4787 00
.....	69301	73000	4	40	465	8095	12040	580	4295	280480	4852 00
88000	69301	92400	4	55	1065	18769	23640	785	9540	315615*	9331 00
88000	69301	92400	4	55	3580	44165	54565	785	29990	315618*	13053 00
110000	92401	115500	4	64	1280	20095	26375	955	11750	315617*	10425 00
110000	92401	115500	4	64	3950	47595	62075	955	34000	315618;	15147 00
132000	115500	138600	4	77	5850	69000	83000	1283	50000	356945;	23330 00
154000	138600	161700	4	84	6144	71000	90000	1500	53000	356714;	25000 00

\*Round tanks, tray structure in one column, tanks mounted on insulated platforms.  
 †Two terminals, tray structures in two columns, tray structure insulated from tanks, tanks may be mounted on any foundation and solidly grounded, thus giving increased protection to operators.

PRICES—TYPE AL IMPULSE GAPS

Style number and list price include type AL impulse gaps complete as described.

Normal	VOLTAGE		Net Weight Erected	WEIGHT IN POUNDS		Style No.	List Price
	Minimum	Maximum		Approximate Weight	Shipping Weight		
<b>Indoor</b>							
.....	10000	15000	250	450	323890	8444 00	
<b>Outdoor</b>							
.....	10000	15000	550	880	306361	645 00	
<b>Indoor and Outdoor</b>							
.....	15001	25000	575	925	306382	658 00	
.....	25001	37000	650	1040	306383	663 00	
44000	.....	.....	1150	1760	*262070	1052 00	
66000	.....	.....	1480	2480	*277810	1127 00	
88000	.....	.....	3750	5390	312493	3483 00	
110000	.....	.....	3900	5540	312494	3552 00	
132000	.....	.....	4700	6800	357171	4700 00	
154000	.....	.....	4900	7100	357172	5170 00	

\*Style number 262070 listed at normal voltage of 44000 is a 50000 maximum rated impulse gap and style number 277810 listed at normal voltage of 66000 is a 73000 volt maximum rated impulse gap. These gaps may be applied up to maximum rating.

Order by Style Number

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

ACCESSORIES AND PARTS

Copper Tubing for Wiring Arresters

In order to reduce the impedance as much as possible, copper tubing is recommended for use in wiring high-voltage electrolytic arresters. The use of this tubing secures the advantage of a large conductor surface without using large wires and at a lower cost than wires. Copper tubing has the additional advantage of being easy to install and requiring fewer insulators.

Description	Inside Diameter Inches	Outside Diameter Inches	Style No.	List Price
Bend 90 degrees, 6-inch radius	★	3/8	253971	\$1 26 each
Bend 60 degrees, 6-inch radius	★	3/8	253972	1 26 each
Bend 45 degrees, 6-inch radius	★	3/8	253973	1 26 each
Bend 30 degrees, 6-inch radius	★	3/8	253974	1 26 each
Tee connector	★	3/8	253975	1 62 each
Terminal connector	★	3/8	253977	73 each
Connector 2 inches long	★	3/8	253976	24 each
Tubing, any length up to 10 ft.	★	3/8	.....	28 per foot

Charge and Discharge Resistors

The following resistors are 1 inch in diameter and of different lengths according to resistance values. For resistor rods of 3/4-inch or 1 1/2-inch diameter apply to nearest district office, giving reading of nameplate on arrester tank, size of rods desired, voltage of arrester and order number upon which arrester was furnished.

Prices

Style Number Resistor Rod	List Price per Rod
276669	\$3 00
276671	3 00
276672	3 00

Number of Rods

Style Number Resistor Rod	VOLTAGE RANGE OF ARRESTER Minimum Maximum	Number of Rods Required per Arrester	Style Number Resistor Rod	VOLTAGE RANGE OF ARRESTER Minimum Maximum	Number of Rods Required per Arrester
<b>For Type AK Arresters</b>			<b>For Type AK Arresters</b>		
<b>Three-Phase</b>			<b>Single-Phase</b>		
276669	1000 7500	3	276669	1000 7500	2
276671	7501 15000	3	276671	7501 15000	2
276671	15001 25000	6	<b>Two-Phase, Four-Wire</b>		
276672	25001 37000	6	276669	1000 7500	4
276671	37001 46200	12	<b>Two-Phase Three-Wire</b>		
276671	46201 { 50000 } { 69300 } { 73000 }	18	276669	1000 7500	3
276671	73001 92400	24	<b>For Type AL Arresters</b>		
276672	92401 115500	30	<b>Three-Phase</b>		
276671	115501 138600	30	276671	15000	3
276671	88000	24	276671	25000	6
276672	110000	24	276672	37000	6
276671	132000	30	276671	46200	12
276672	154000	30	276671	{ 50000 } { 69300 } { 73000 }	18
			276671	88000	24
			276672	110000	24
			276671	132000	30
			276672	154000	30

Unbalancing Resistors For Type AL Arresters

VOLTAGE RANGE OF ARRESTERS Minimum Maximum	Number Required Per Arrester	Style No.	List Price Each
10000 73000	6	280498	\$5 45
Porcelain container for Style No. 280498	6	277637	5 65

Trays (For Types A [D-C.], AK and AL [A-C.] Arresters)

The prices of the trays and the number required to completely make over the tray structure of the arresters are given in the tables below.

Prices

Description	Style No.	List Price Each
Aluminum tray (treated) without connection lug.....	229147	\$1 55
Aluminum tray (treated) with connection lug.....	229148	1 85

Order by Style Number

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

Number of Trays Required

Style No. Arresters	No. of Trays 229147	No. of Trays 229148	Style No. Arresters	No. of Trays 229147	No. of Trays 229148	Style No. Arresters	No. of Trays 229147	No. of Trays 229148
<b>Type AK, Three-Phase</b>								
292786	20	6	231434	532	None	<b>Type AL, Three-Phase</b>		
292787	32	6	315619	676	None	282247	104	6
292788	52	6	315620	676	None	306364	184	None
272967	104	6				306365	272	None
			315621	840	None	289635	340	None
306369	184	None	315622	840	None	262051	368	None
306370	272	None	315623	1024	None			
289642	340	None	315624	1188	None	289636	512	None
280845	368	None	<b>Type AK, Two-phase, Four-wire</b>			282042	532	None
			266740	15	8	306366	104	6
			266743	55	8	306367	184	None
289641	512	None	<b>Type AK, Two-phase, Three-wire</b>			306368	272	None
280847	532	None	266746	16	6	289637	340	None
266821	52	6	266749	50	6	262050	368	None
306371	112	None	<b>Type AK, Single-phase</b>			289638	512	None
			266752	12	5	280480	532	None
306372	184	None	266755	36	5	315615	676	None
306373	272	None	266757	75	5	315616	676	None
289639	340	None				315617	840	None
231430	368	None				315618	840	None
289640	512	None				356945	1024	None
						353714	1118	None

Type D Electrolyte

Dry

AMOUNT OF LIQUID ELECTROLYTE TO BE MADE FROM CONTENTS OF JAR		APPROXIMATE WT.		Jar Filled With Dry Electrolyte	List Price
Gal.	Liters	Net	Shipping	Style No.	
1	3.8	7.8 oz.	2 lbs.	276310	\$ 90
2	7.6	15.6 "	2.5 "	276311	1 80
3	11.4	23.4 "	3 "	280788	2 65
4	15.2	32.2 "	4 "	276312	3 50
8	30.3	62.4 "	6 "	280789	7 15
16	60.5	124.8 "	22 "	280790	14 25
32	121.0	249.6 "	36 "	280791	28 50

Liquid

\*Type D liquid electrolyte per gallon without container . . . . . \$ 90 List each  
 Type FX liquid electrolyte per gallon without container . . . . . 90  
 12-Gallon glass carboy . . . . . \*  
 5-Gallon glass carboy . . . . . \*  
 \*Quantity specified on order will be shipped only in the above size carboys. For all carboys returned at shipper's risk, transportation charges prepaid, and received at East Pittsburgh in good condition, a credit of the net price as given on invoice covering shipment will be allowed. Classification of these returned carboys as "empty carboys returned" will insure lowest obtainable freight rate. A copy of bill-of-lading with full reference to original order or invoice number must be forwarded to the district office handling the order to insure prompt issuance of credit memorandum.

Oil—Standard transformer oil is used in all electrolytic arresters. See section 5-A of this catalogue, "Insulation and Supplies," for prices.

Charging-Current Indicators

Charging-current indicators, for use in measuring the current taken by the types AK or AL arresters in charging, consist of an ammeter mounted on the switch stick and a set of jacks mounted on the arrester tanks, on the bushings, or on the horn, sphere or impulse gaps, depending on the construction of the arrester. The jack is, in reality, a receptacle arranged for the insertion of the switch stick, and is so connected in the arrester circuit, that when the stick is inserted and the gaps short circuited, the charging current flows through and is indicated on the ammeter.

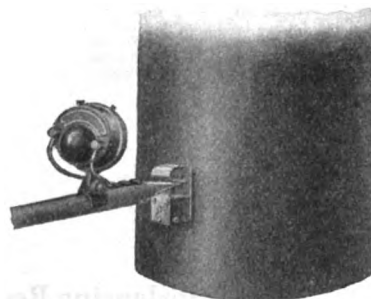


FIG. 20—CHARGING-CURRENT INDICATOR FOR USE ON TYPE AK LIGHTNING ARRESTERS

Electrolytic Arrester Charging-Jack Equipment

Description	No. of Each Style Required† per Arrester	Style No.*	List Price Each
Up to 7500 volts indoor (pipe frame mounting) . . . . .	4†	248115	\$ 9 70
7501 to 15000 volts, inclusive, indoor. (pipe frame mounting) . . . . .	4†	248116	9 70
15001 to 50000 volts, inclusive, indoor . . . . .	1	316161	32 50
7501 to 50000 volts, inclusive, outdoor . . . . .	1	316161	32 50
50001 to 73000 volts inclusive, indoor or outdoor . . . . .	1	316162	40 50
88000 to 110000 volts, outdoor, for round tank arresters . . . . .	1	321349	48 50
88000, 110000, 132000, and 154000 volts, outdoor, for elliptical tank arresters . . . . .	1	321350	56 50
Charging-current switch stick with ammeter for voltages up to 15000 . . . . .		201604	40 50
Charging-current switch stick with ammeter for voltages 15001 to 50000 . . . . .		201605	40 50
Charging-current switch stick with ammeter for voltages 50001 to 73000 . . . . .		201608	44 50
Charging-current switch stick with ammeter for voltages 73001 to 115500 . . . . .		201607	49 50
Charging-current switch stick with ammeter for voltages 115501 to 138600 . . . . .		201608	51 00

\*Style No. covers jack with tank insulating strips.  
 †The number of each style required is that necessary for a three-phase four-pole arrester.  
 ‡Three may be used instead of four if placed on the line side of the gaps.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

ALARM BELL ATTACHMENT

An alarm bell attachment, which can be connected to the ground lead of the arrester to indicate when a discharge is taking place, can be furnished at extra cost. This attachment consists of a small safety spark gap, around which is shunted an alarm bell. Another more satisfactory but more expensive form

of this device substitutes a small electrolytic cell for the spark gap, which reduces the danger of puncturing the bell winding. The bell itself may be placed at any desirable point with leads from it connecting to the arrester.

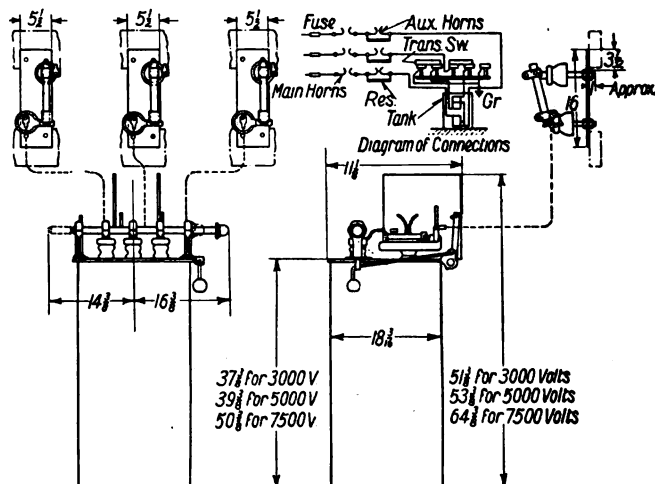
Description	Style No.	List Price Each
Alarm bell attachment including safety spark gap and alarm bell.....	198590	\$ 65 00
Alarm bell attachment including electrolytic cell and alarm bell.....	182908	142 00
Alarm bell alone.....	119083	49 00

MISCELLANEOUS

Description	Style No.	List Price
Porcelain spacing block for trays.....	139794	Per 100, \$2 40
Cup for filling trays 200 C. C.....	124412	Each, 1 80

APPROXIMATE DIMENSIONS IN INCHES

TYPE AK—INDOOR—THREE-PHASE

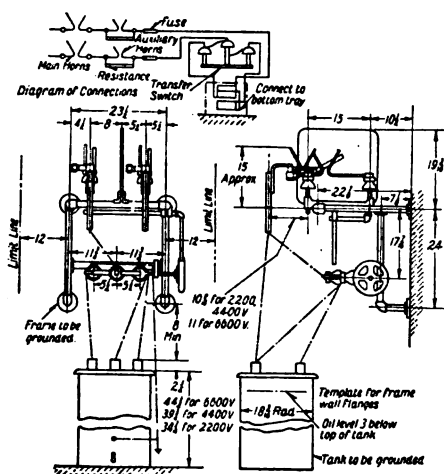


Style No.	VOLTAGE		APPROX. NO. GAL. REQ.	
	Min.	Max.	Electrolyte	Oil
292786	1000	3000	1 1/4	38
292787	3001	5000	3	46
272788	5001	7500	4 1/2	55

TYPE AK—INDOOR—SINGLE-PHASE

Style No.	VOLTAGE		APPROX. NO. GALLONS REQUIRED	
	Min.	Max.	Electrolyte	Oil*
266752	1000	3000	1 1/4	34
266755	5001	7500	3	46

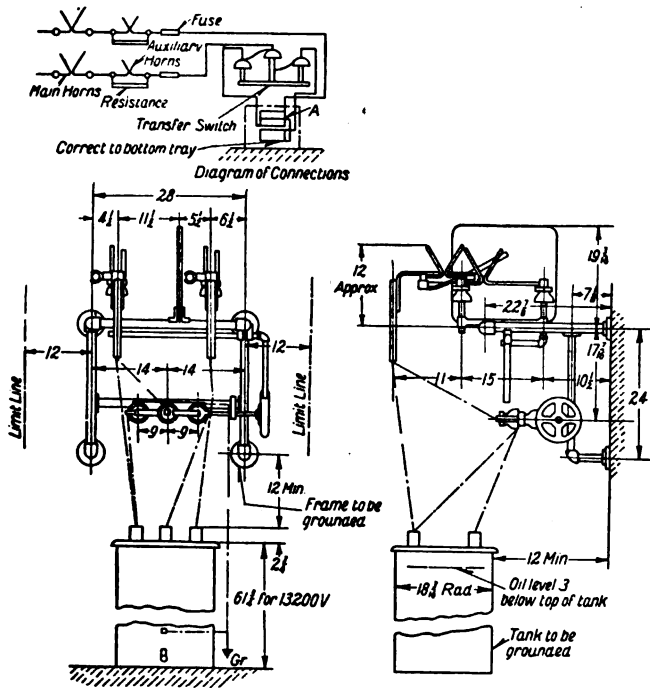
\*Wemco A Oil preferred. These dimensions are for reference only. For official dimensions apply to nearest district office.



Order by Style Number

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AK—INDOOR—SINGLE-PHASE



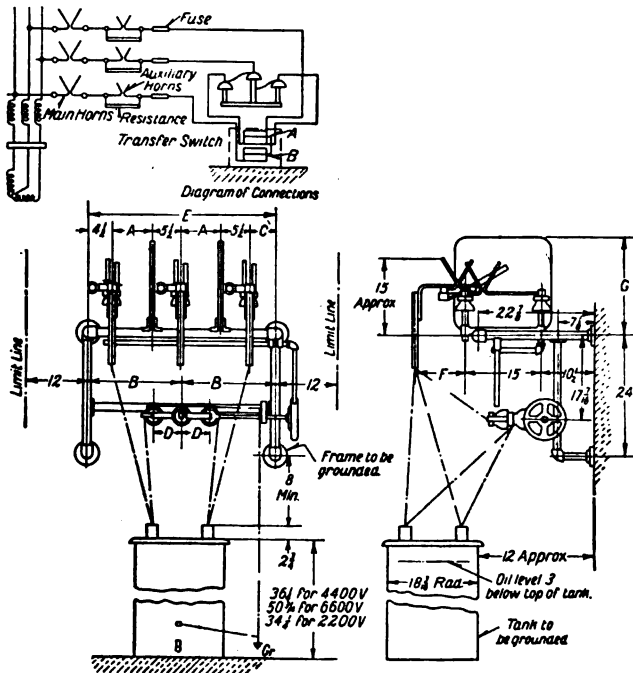
Style No. 266757

\*Wemco A oil preferred.

VOLTAGE	
Minimum	Maximum
7501	15000

APPROX. No. GALLONS REQUIRED	
Electrolyte	Oil*
6	66

TYPE AK—INDOOR—TWO-PHASE—THREE-WIRE



Style No. 266748  
266749

\*Wemco A Oil preferred.

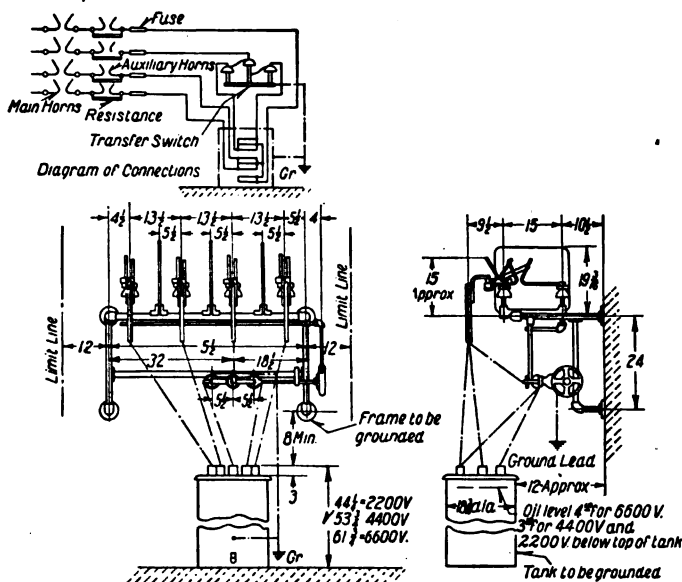
These dimensions are for reference only. For official dimensions apply to nearest district office.

Minimum	Maximum	APPROX. No. GAL. REQUIRED		DIMENSIONS IN INCHES						
		Electrolyte	Oil*	A	B	C	D	E	F	G
1000	3000	1 1/2	39	8	18 1/2	5 1/2	5 1/2	37	10 1/2	19 1/2
5000	7500	4 1/2	52	11 1/2	22 1/2	6 1/2	9	39	11	19 1/2



TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AK—INDOOR—TWO-PHASE—FOUR-WIRE



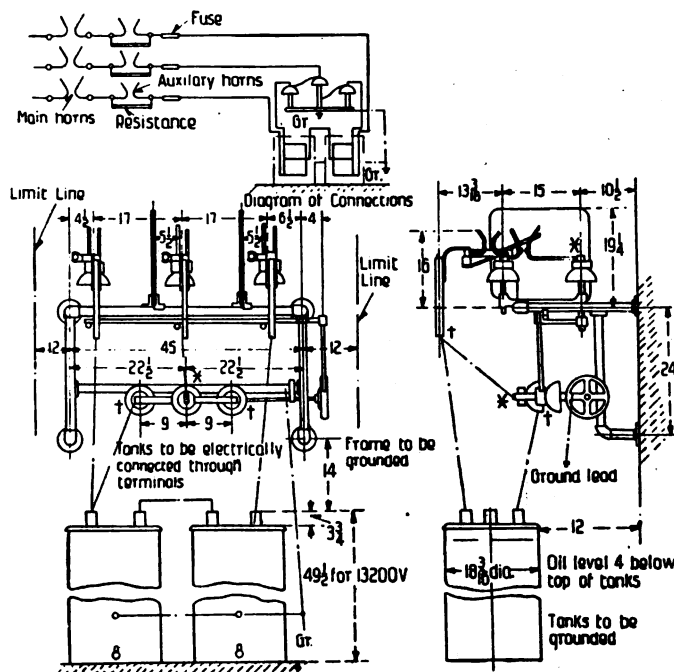
Style No.  
266740  
266743

VOLTAGE	
Minimum	Maximum
1000	3000
5000	7500

APPROX. NO. GALLONS REQUIRED	
Electrolyte	Oil*
1 3/4	40
4 1/2	58

\*Wemco A Oil preferred.

TYPE AK—INDOOR—THREE-PHASE



Style No.  
272987

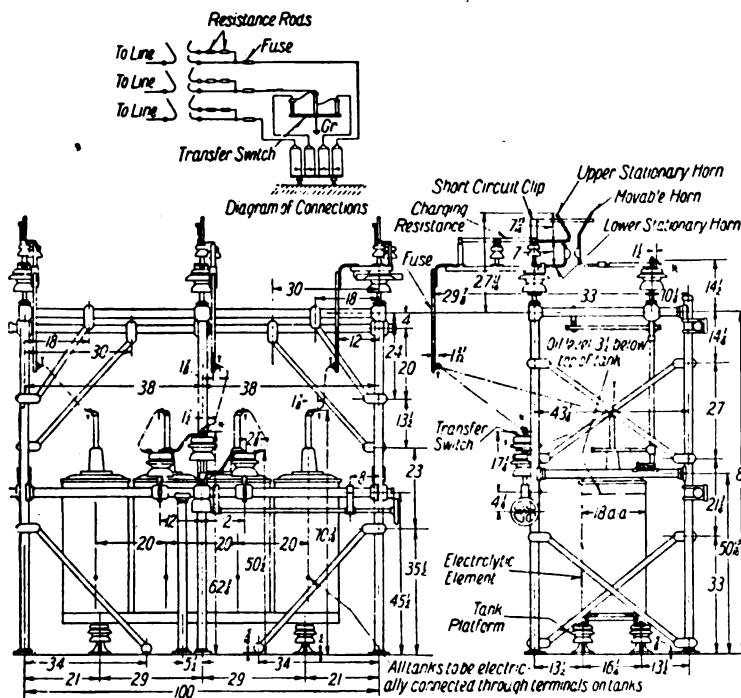
VOLTAGE	
Minimum	Maximum
7501	15000

APPROX. NO. GALLONS REQUIRED	
Electrolyte	Oil*
7 3/4	92

\*Wemco A Oil preferred.  
These dimensions are for reference only For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AK—INDOOR—THREE-PHASE



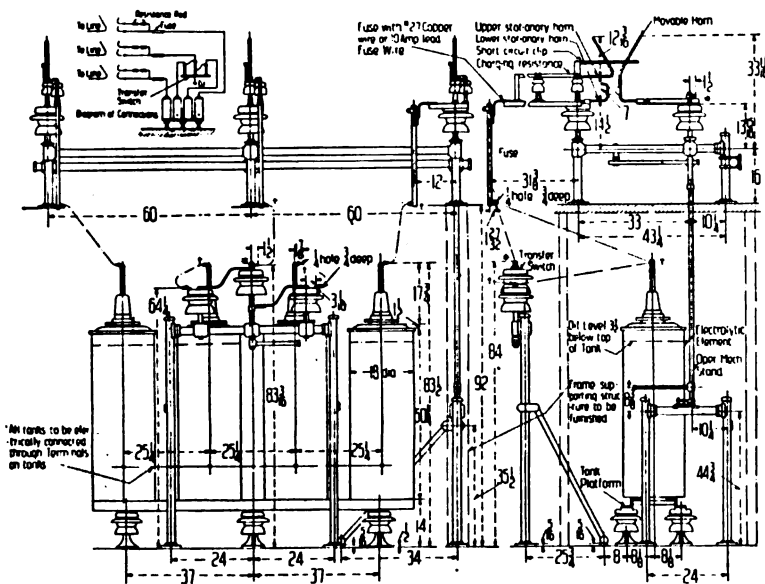
Style No.  
308369

VOLTAGE	
Minimum	Maximum
15001	25000

APPROX. NO. GALLONS REQUIRED	
Electrolyte	Oil*
13 1/2	138

\*Wemco A Oil preferred.

TYPE AK—INDOOR—THREE-PHASE



Style No.  
308370

VOLTAGE	
Minimum	Maximum
25001	37000

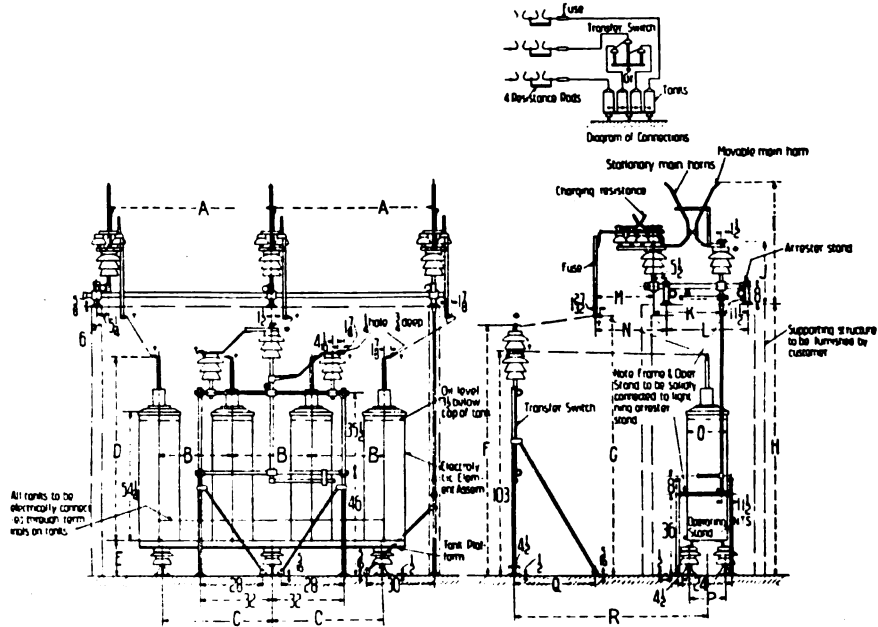
APPROX. NO. GALLONS REQUIRED	
Electrolyte	Oil*
22	192

\*Wemco A Oil preferred.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

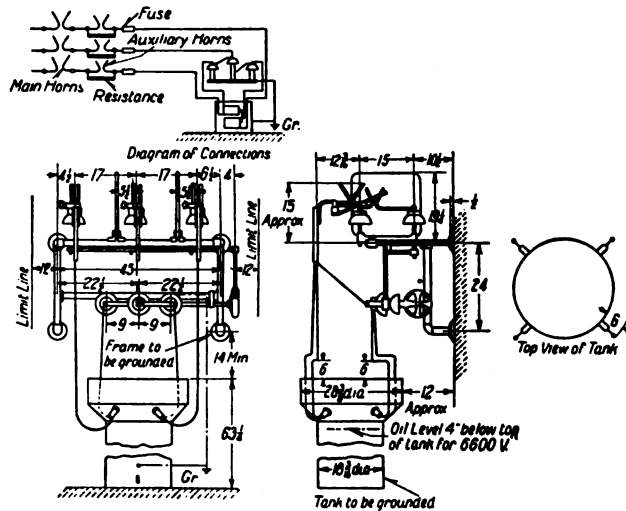
TYPE AK—INDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. No. GAL REQ.		DIMENSIONS IN INCHES																	
	Min.	Max.	Elect.	Oil*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
289642	37001	46200	25	203	72	30	49	79 3/4	15 3/4	111 3/4	116 3/4	132	57 1/2	28 3/4	30	36	26 1/2	31 1/2	18	16 1/2	30	54 1/2
280845	46201	50000	27	211	72	30	49	81 1/2	15 3/4	111 3/4	116 3/4	132	57 1/2	28 3/4	30	36	26 1/2	31 1/2	18	16 1/2	30	54 1/2
289641	46201	69300	38	454	96	34	54	112 1/2	21	112	142 1/2	162	63 1/2	31 1/2	42	48	27 1/2	32 1/2	22 1/2	20 1/2	36	72
280847	69301	73000	40	465	96	34	54	114 3/4	21	112	142 1/2	162	63 1/2	31 1/2	42	48	27 1/2	32 1/2	22 1/2	20 1/2	36	72

\*Wemco A Oil preferred.

TYPE AK—OUTDOOR—THREE-PHASE



Style No. 268821

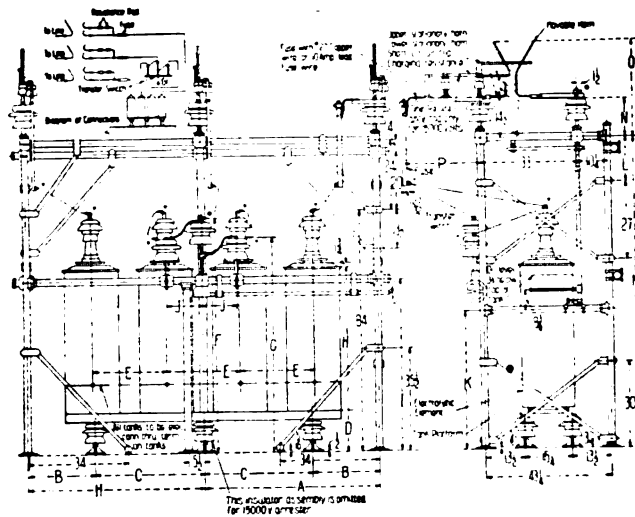
Minimum VOLTAGE 5000 Maximum 7500

APPROX. No. GALLONS REQUIRED Electrolyte 4 1/2 Oil\* 55

\*Wemco A Oil preferred. These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

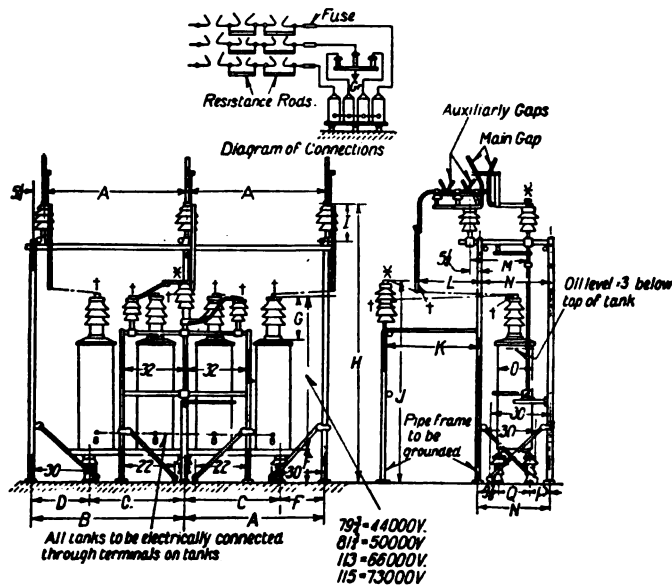
TYPE AK—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES															
	Min.	Max.	Elect.	Oil*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
304371	7501	15000	7 3/4	102	50	21	29	12	20	62 3/4	67 3/4	52 1/2	45 1/2	12	50 1/2	14 1/2	96	13 1/2	27 1/2	18 1/2
304372	15001	25000	13 1/2	138	50	21	29	12	20	62 3/4	67 3/4	67 3/4	45 1/2	12	50 1/2	14 1/2	96	14 1/2	27 1/2	29 1/2
304373	25001	37000	22	192	60	23	37	14	25 1/4	81	74	84 1/2	59	14	44 3/4	15 1/2	108	13 1/2	33 1/2	31 3/4

\*Wemco A Oil preferred.

TYPE AK—OUTDOOR—THREE-PHASE



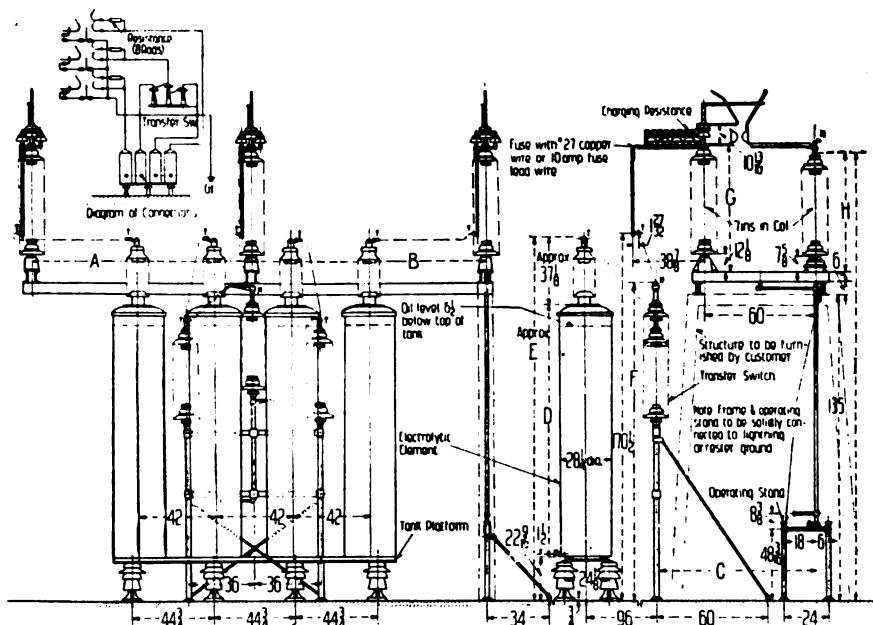
Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES																
	Min.	Max.	Elect.	Oil*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
289639	37001	46200	25	203	72	77 1/4	49	28 1/4	23	17	24	145	19	108 1/2	68	31 3/8	30	36	18 3/4	9 3/4	16 1/4
231430	46201	50000	27	211	72	77 1/4	49	28 1/4	23	17	24	145	19	108 1/2	68	31 3/8	30	36	18 3/4	9 3/4	16 1/4
289640	46201	69300	38	454	96	101 1/4	54	47 1/4	32	20	32	184	22	112	72	36 3/4	44	48	22 1/4	13 1/4	20 1/4
231434	69301	73000	40	465	96	101 1/4	54	47 1/4	32	20	32	184	22	112	72	36 3/4	44	48	22 1/4	13 1/4	20 1/4

\*Wemco A Oil preferred.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

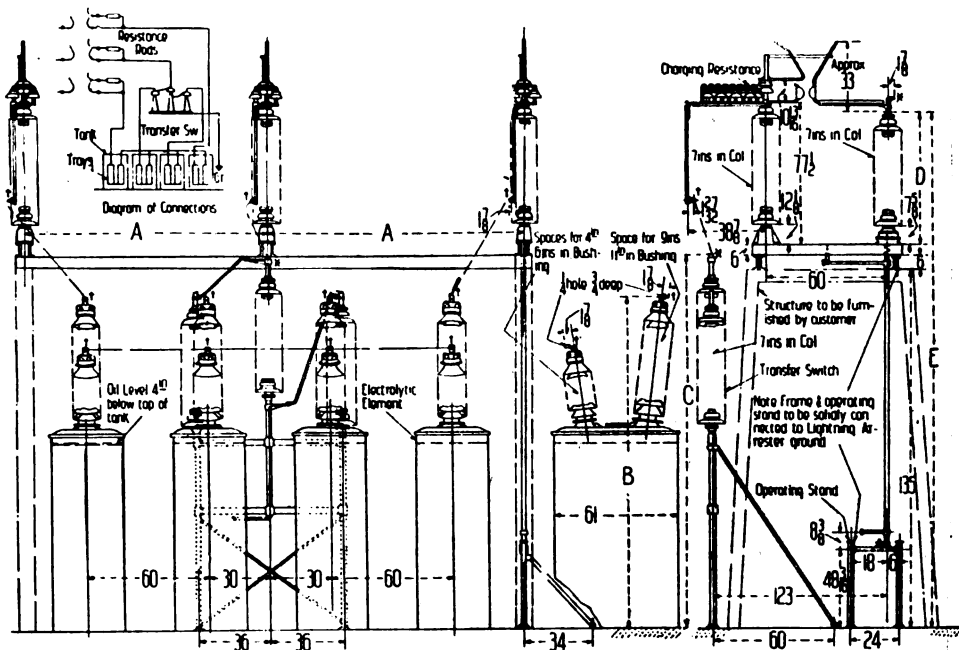
TYPE AK—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES								
	Min.	Max.	Elect.	Oil*	A	B	C	D	E	F	G	H	I
315619	69301	92400	55	1065	108	114	120	117	155 3/4	173 1/2	61 1/2	57 3/4	207
315621	92401	115500	64	1280	120	126	123	138 1/2	198 3/4	181 1/2	69 3/4	65 3/4	215

\*Wemco A Oil preferred.

TYPE AK—OUTDOOR—THREE-PHASE



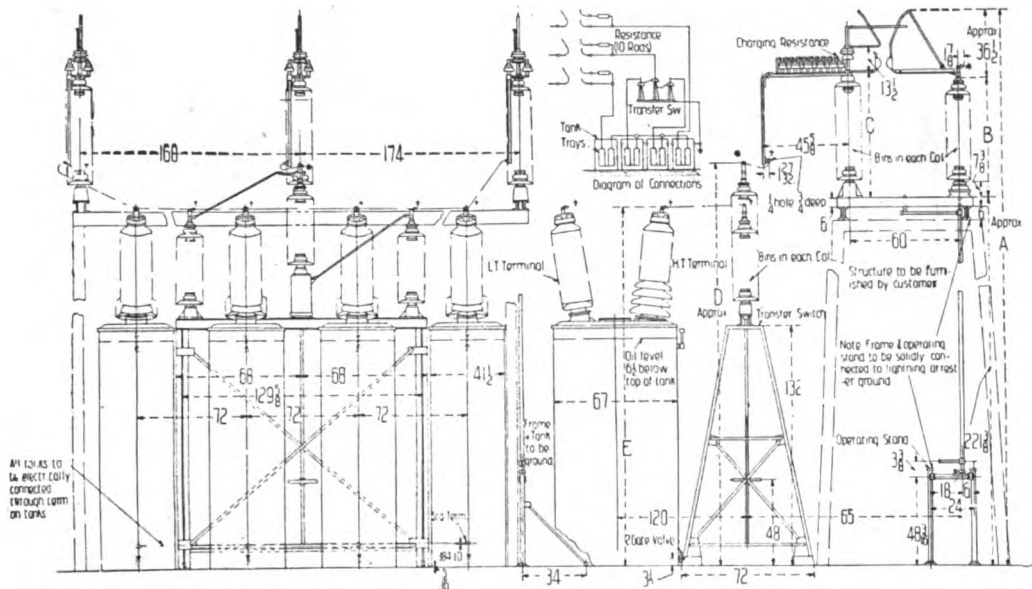
Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES				
	Minimum	Maximum	Electrolyte	Oil*	A	B	C	D	E
315620	69301	92400	55	3580	96	144 3/4	173 3/4	57 3/4	207
315622	92401	115500	64	3950	126	160	196	65 3/4	215

\*Wemco A Oil preferred.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

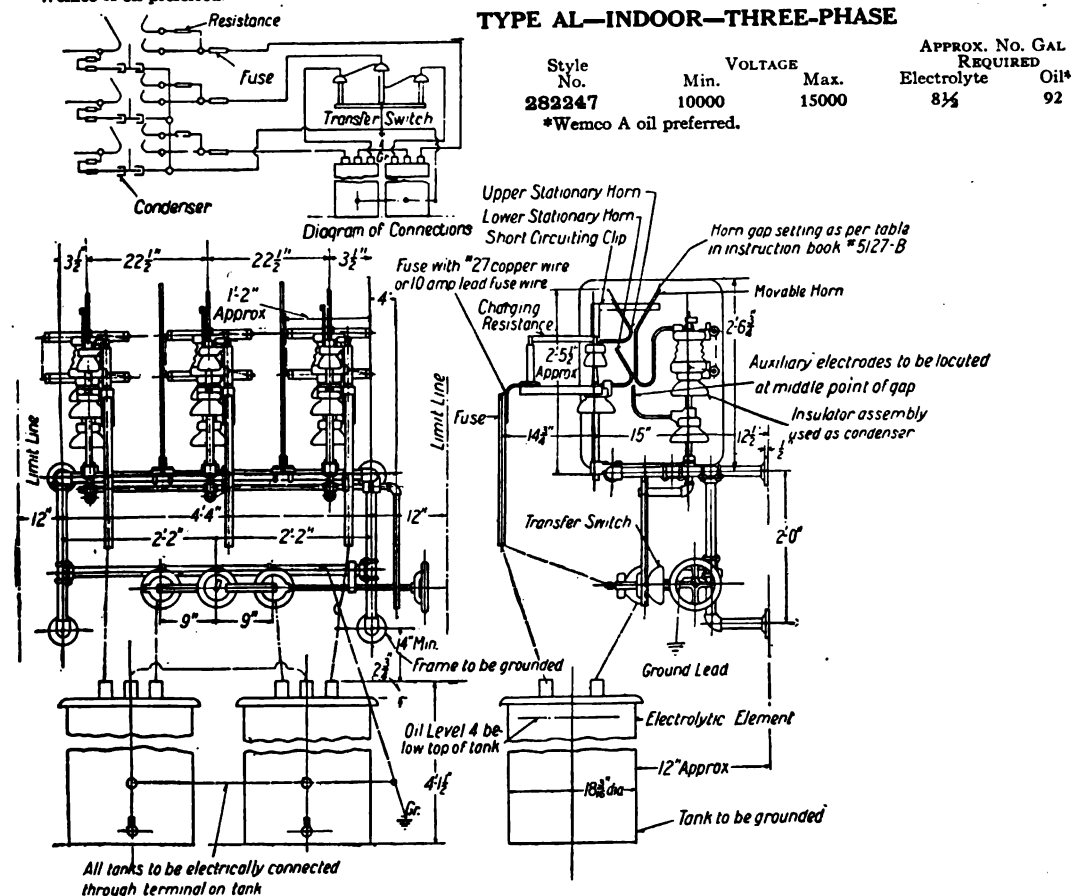
TYPE AK—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES				
	Minimum	Maximum	Electrolyte	Oil*	A	B	C	D	E
315623	115501	138600	77	5850	332 1/2	73 3/4	77 1/2	243 1/2	217 1/2
315624	138601	161700	84	6144	348 3/4	89 3/4	93 1/2	259 1/2	239 1/2

\*Wemco A oil preferred.

TYPE AL—INDOOR—THREE-PHASE



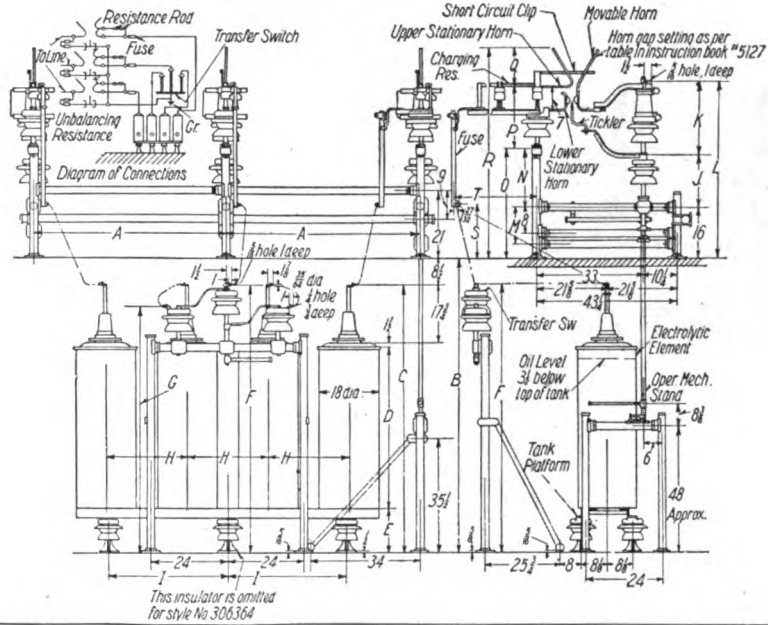
Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED	
	Min.	Max.	Electrolyte	Oil*
282247	10000	15000	8 1/2	92

\*Wemco A oil preferred.

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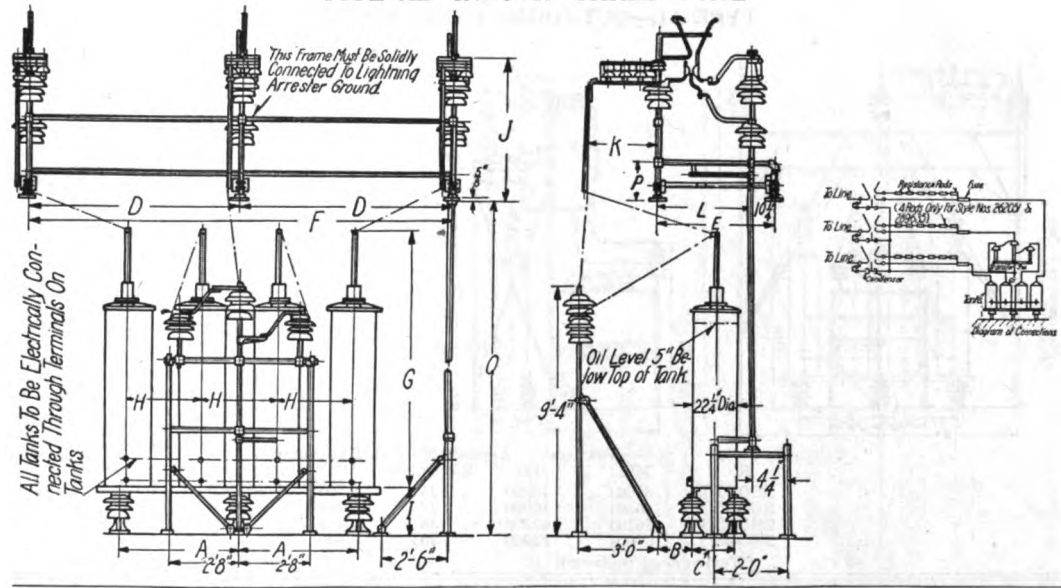
TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AL—INDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES																			
	Min.	Max.	Elec-trolyte	*Oil*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
306364	15001	25000	13 1/2	138	50	80	68	37	11 1/2	73 3/8	68	20	29	14	19 1/4	49 1/4	12 1/2	15 3/8	31 3/8	17 1/8	6	57 3/8	18 3/8	29 1/8
306365	25001	37000	20	192	60	92	83 1/2	50 1/2	14	83 3/8	76 1/4	25 1/4	37	16 3/8	22 3/8	54 3/8	11 1/2	18 3/8	34 3/8	19 3/8	12 3/8	65 3/8	16 1/2	31 3/8

TYPE AL—INDOOR—THREE-PHASE

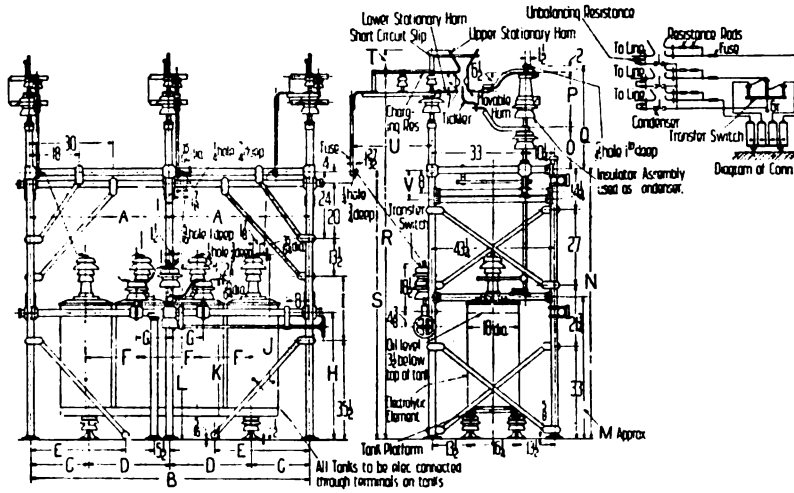


Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES																			
	Min.	Max.	Elec-trolyte	*Oil*	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q			
289635	37001	46200	25	203	49	10	16 1/4	70 3/8	49 3/4	141 1/2	79 1/4	30	15 3/8	64 3/4	31 3/4	39 1/2	1 3/4	13 3/4	6 1/2	16 1/2	109 1/2			
282051	46201	50000	27	211	49	10	16 1/4	70 3/8	49 3/4	141 1/2	81 3/4	30	15 3/8	64 3/4	31 3/4	39 1/2	1 3/4	13 3/4	6 1/2	16 1/2	109 1/2			
289638	46201	69300	38	454	54	16	20 1/4	94 1/8	52 3/4	189	112	34	21	65 3/8	33 1/4	42	2 3/8	2 3/8	10	18 3/8	149 1/2			
282042	69301	73000	40	465	54	16	20 1/4	94 1/8	52 3/4	189	114 3/8	34	21	65 3/8	33 1/4	42	2 3/8	2 3/8	10	18 3/8	149 1/2			

\*Wemco A oil preferred. These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AL—OUTDOOR—THREE-PHASE

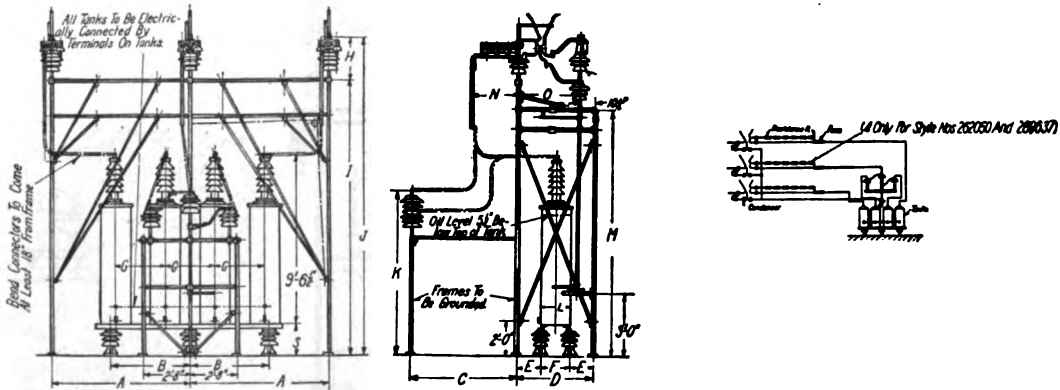


Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED	
	Min.	Max.	Electrolyte	Oil*
306366	10000	15000	8½	102
306367	15001	25000	13½	138
306368	25001	37000	20	192

\*Wemco A oil preferred.

Style No.	DIMENSIONS IN INCHES																				
	A	B	C	D	E	F	G	H	I	J	L	M	N	O	P	Q	R	S	T	U	V
306366	50	100	21	29	30	20	12	45½	23	52½	62¾	50¾	96	11	14¾	27¾	124¾	93¾	7¾	18¾	10½
306367	50	100	21	29	30	20	12	45½	23	67¾	62¾	48¾	96	14	19¾	35¾	129¾	92¾	7¾	29¾	10½
306368	60	120	23	37	34	25½	14	59¾	35	84	81	48	108	16¾	25¾	36¾	145¾	107¾	12¾	31¾	11½

TYPE AL—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED	
	Min.	Max.	Electrolyte	*Oil
289637	37001	46200	25	203
282050	46201	50000	27	211
289638	46201	69300	38	454
280480	69301	73000	40	465

\*Wemco A oil preferred.

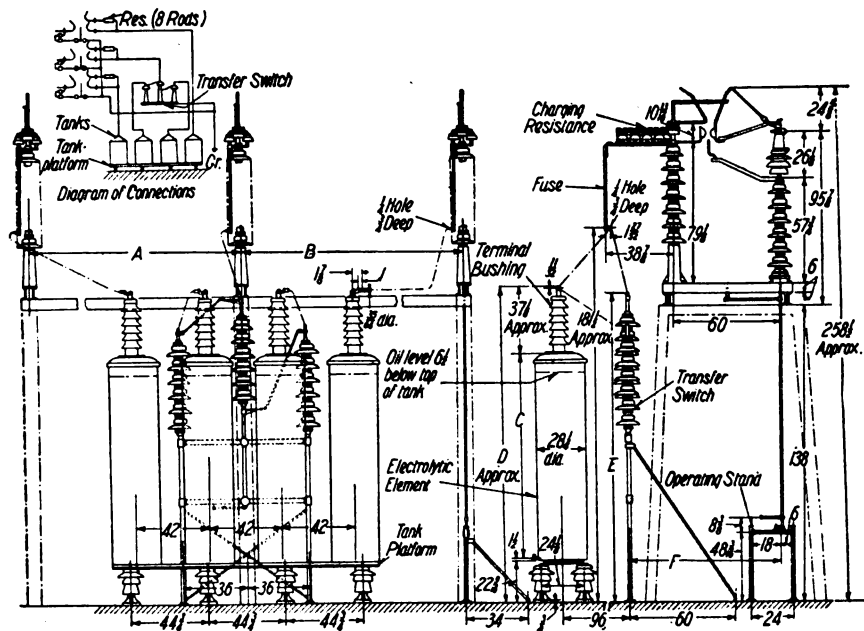
Style No.	DIMENSIONS IN INCHES																	
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
289637	70 1/8	49	32	49 3/4	16 3/4	16 1/4	30	26 1/4	141 1/2	167 3/4	112 1/2	18 1/8	126	31 3/4	39 1/4	1 3/4	6 1/4	112
282050	70 1/8	49	32	49 3/4	16 3/4	16 1/4	30	26 1/4	141 1/2	167 3/4	112 1/2	18 1/8	126	31 3/4	39 1/4	1 3/4	6 1/4	114 1/2
289638	84 1/2	54	72	52 1/4	16	20 1/4	34	29	186	215	112	22 3/4	168	32 3/4	42	2 3/8	10	112
280480	84 1/2	54	72	52 1/4	16	20 1/4	34	29	186	215	112	22 3/4	168	32 3/4	42	2 3/8	10	114 1/2

These dimensions are for reference only. For official dimensions apply to the nearest district office.



TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

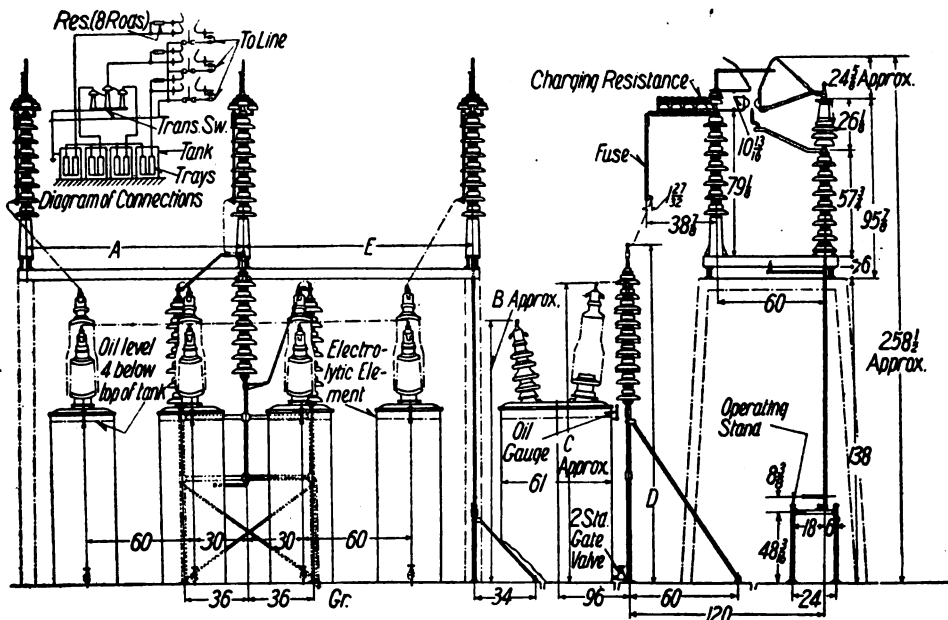
TYPE AL—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES					
	Min.	Max.	Electrolyte	Oil*	A	B	C	D	E	F
315815	69301	92400	55	1065	108	114	117	176 1/2	171 1/2	123
315817	92401	115500	64	1280	120	126	138 1/2	198 1/2	181 1/2	120

\*Wemco A oil preferred.

TYPE AL—OUTDOOR—THREE-PHASE

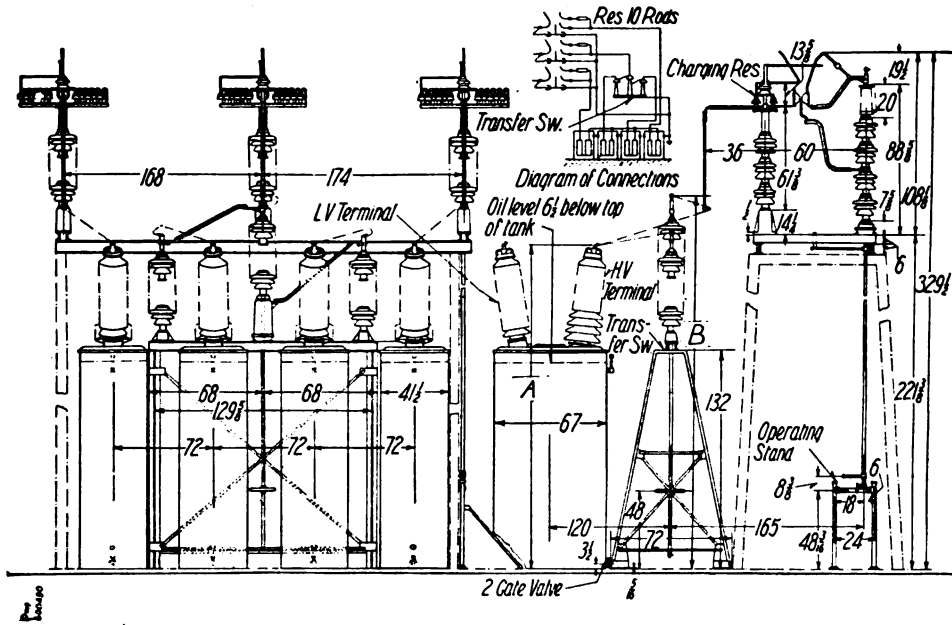


Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES				
	Min.	Max.	Electrolyte	Oil*	A	B	C	D	E
315818	69301	92400	55	3580	108	158 1/2	171	188	114
315818	92401	115500	64	3950	120	168 1/2	202 1/2	196	126

\*Wemco A oil preferred.  
These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

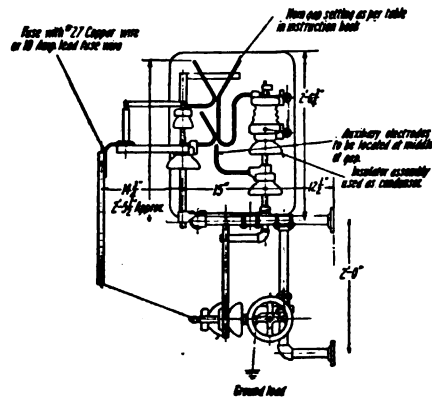
TYPE AL—OUTDOOR—THREE-PHASE



Style No.	VOLTAGE		APPROX. NO. GAL. REQUIRED		DIMENSIONS IN INCHES	
	Min.	Max.	Electrolyte	Oil*	A	B
356945	115500	138600	77	5850	217 1/4	222 3/4
356714	138600	161700	84	6144	229 3/4	259 3/4

\*Wemco A oil preferred.

TYPE AL IMPULSE GAP

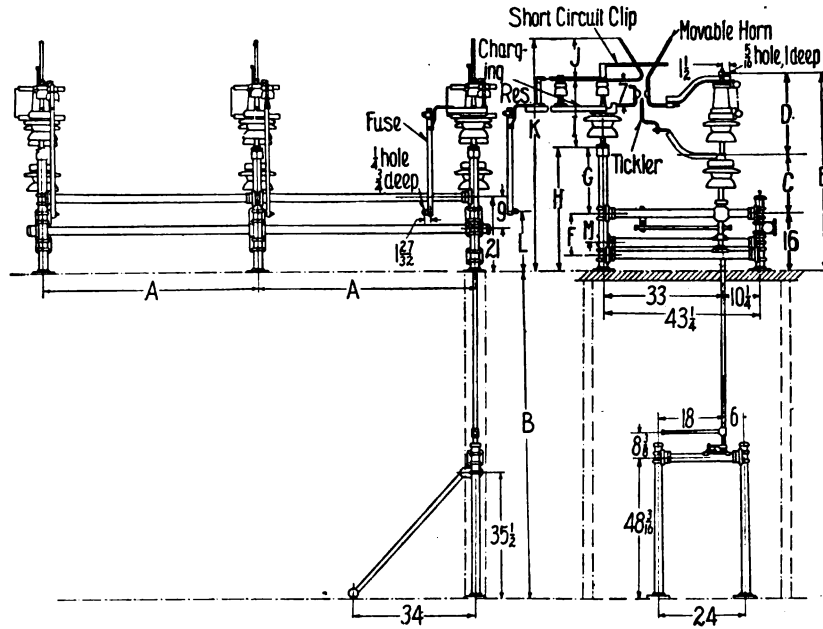


For Style No. 323890

These dimensions are for reference only. For official dimensions apply to nearest district office.

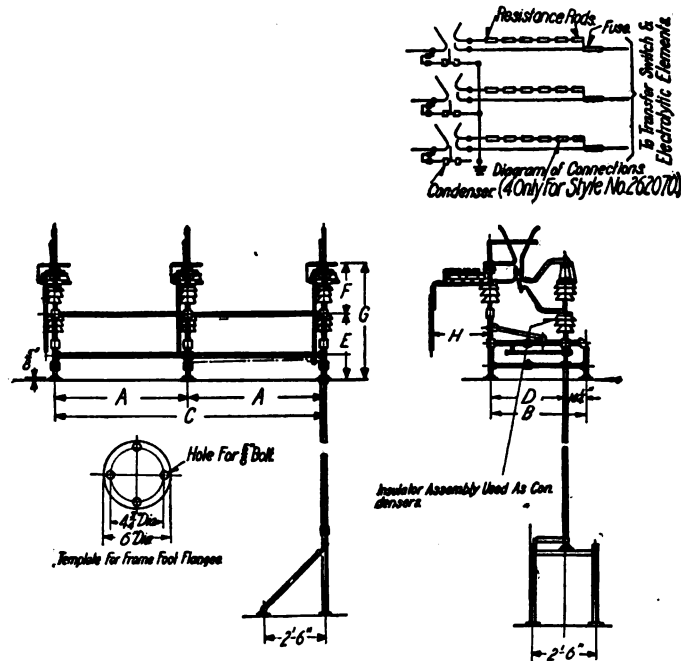
TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

TYPE AL IMPULSE GAP



Style No.	VOLTAGE		DIMENSIONS IN INCHES												
	Min.	Max.	A	B	C	D	E	F	G	H	I	J	K	L	M
308361	10000	15000	50	80	11	14 3/4	43 3/4	10 1/2	13 3/4	29 3/4	15	7 3/4	52 1/2	7 3/4	8
308362	15001	25000	50	80	14	19 3/4	49 3/4	12 1/2	16 3/4	31 3/4	19 1/2	6 3/4	57 3/4	10 1/2	9
308363	25001	37000	60	92	16 3/4	22 3/4	54 3/4	11 3/2	18 3/4	34 3/4	19 3/2	12 3/4	65 3/4	16 1/2	8

TYPE AL IMPULSE GAP

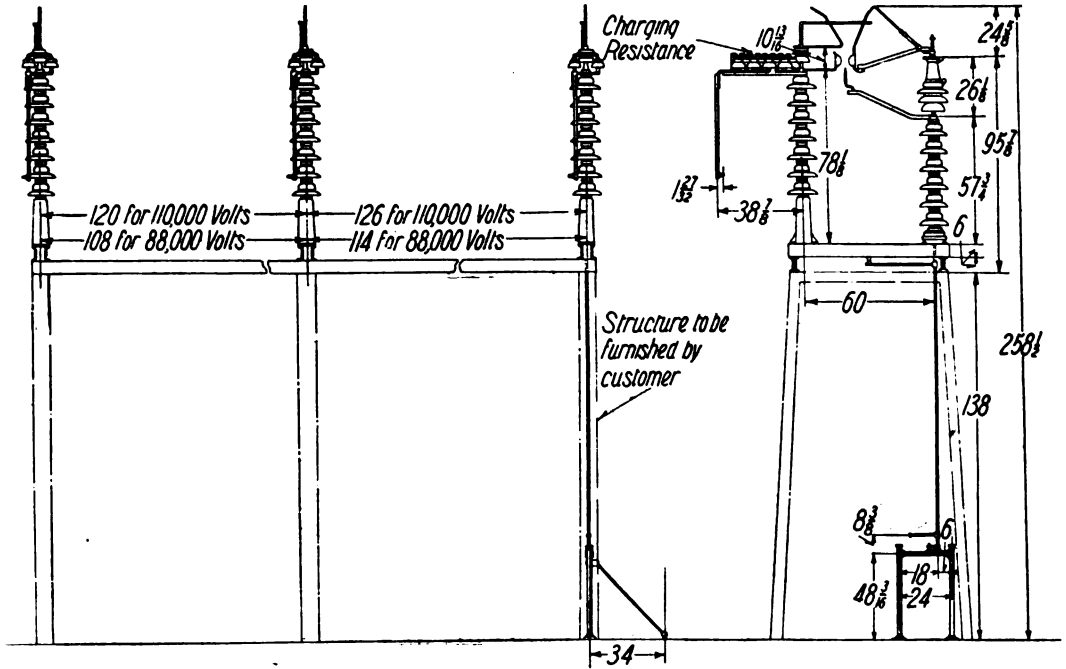


Style No.	Voltage Normal	DIMENSIONS IN INCHES							
		A	B	C	D	E	F	G	H
262070	44000	70 3/4	49 3/4	141 3/4	39 3/4	35 1/4	26 1/4	61 1/4	31 1/4
277810	66000	94 3/2	52 3/4	189	42	36 3/4	29	65 3/4	33 3/4

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPES AK AND AL ELECTROLYTIC LIGHTNING ARRESTERS—Continued

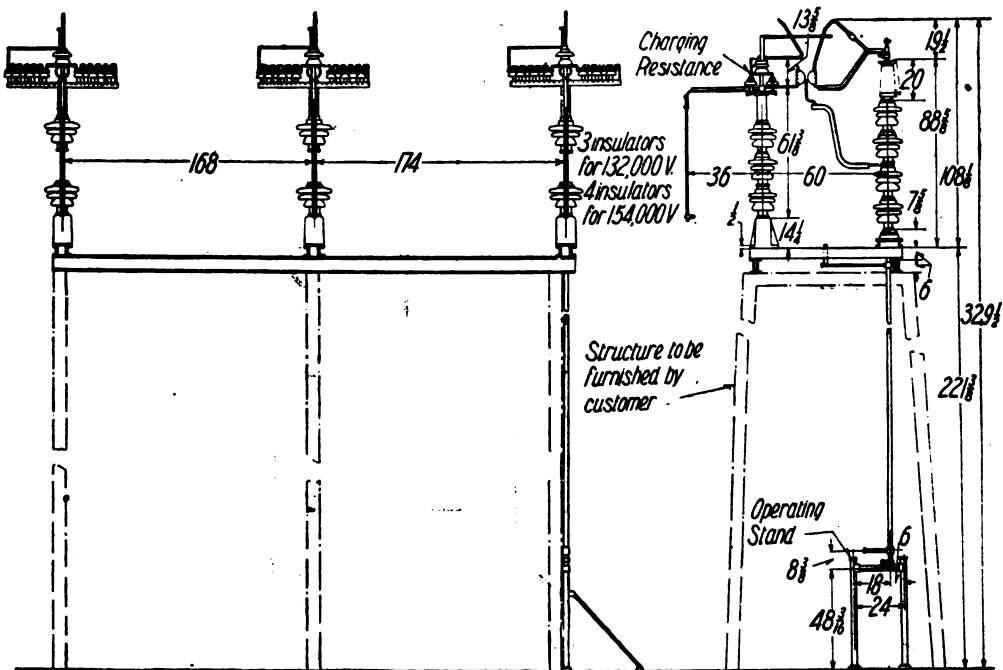
TYPE AL IMPULSE GAP



Style No.  
312493  
312494

Normal Voltage  
88,000  
110,000

TYPE AL IMPULSE GAP



Style No.  
357171  
357172

Normal Voltage  
132,000  
154,000

These dimensions are for reference only. For official dimensions apply to nearest district office.

## CHOKO COILS

### For Direct and Alternating-Current Light and Power Circuits

The effectiveness of a choke coil depends primarily upon its inductance. The approximate inductance of a helical choke coil may be calculated from the following formula.  $L = 4\pi a^2 n^2 l$  (This is an approximate formula. For accurate formula see formula 53, page 38 of Reprint No. 93 of the U. S. Bureau of Standards.) In this formula  $L$  is the inductance in C.G.S. units,  $a$  the radius in centimeters,  $n$  the number of turns per centimeter and  $l$  is the length of the coil in centimeters. This formula may be written  $L = (\pi d^2 n^2 l) 10^{-6}$  where  $L$  is in millihenrys and  $d$  is the diameter in centimeters. From this it is apparent that the inductance of the coil is proportional to the square of the diameter, to the square of the number of turns and directly proportional to the length.

Whenever a surge of high frequency or a steep wave front due to lightning or any other cause travels along a line and strikes an inductive winding it builds up a high voltage between the end turns of that winding, a high voltage to ground, and reflects the surge back onto the line. Surges due to atmospheric lightning are usually of very high frequency whether or not of high voltage to ground.

They may cause a break down of the insulation between turns or to ground through which a heavy power current may flow and cause great damage. It is necessary, therefore, that the choke coil be strongly insulated both between turns and to ground.

Besides relieving the end turns of equipment by receiving the first shock of the surge and flattening it out before it can enter the power apparatus, the choke coil, by delaying the progress of the surge and piling up the voltage momentarily at the line end of the choke coil, gives the lightning arrester more time and a greater tendency to discharge and relieve the line. The delay introduced by the choke coil gives sufficient time for the surge to overcome the dielectric strength of the arrester gaps and permits the arrester to discharge the disturbance to ground. This is easily accomplished as the reflected portion of the surge, due to the action of the choke coil is of higher voltage. With commercial choke coils a portion of the surge may pass through the coil, but its wave front will then have been considerably smoothed out and its frequency lowered. Low frequency and low-inclined wave front surges usually cause little if any damage to the end turns of generators, transformers, or similar equipment.

The impedance of a choke coil varies with the frequency, hence on a high frequency disturbance such as is experienced under lightning conditions, the impedance of the coil will be high, whereas at commercial frequencies the impedance will be practically nil.

Theoretically each line of a system has a choke coil best suited for its needs in giving protection.

In commercial work, however, it is necessary to design choke coils which will meet general conditions. In the design of commercial coils care is taken not to make the inductance such as might cause, due to the presence of the choke coil in the circuit, a resonant voltage at the terminals of various equipment connected to the line. Due to this possibility, it is not good practice to use choke coils for the protection of cable systems, where the cables are more than 2600 feet long, because of the capacitance of the cables. The introduction of choke coils in cable systems may bring out a resonant voltage condition that would be undesirable.

In practice it has been found that choke coils are subject to strong mechanical strains, due to short circuits on the systems in which they are connected. Under short circuit conditions, etc., there is a tendency to draw the turns of a coil close together, to draw all the turns toward one end and also to tip the coil sidewise at an angle to its axis. Due to the strains to which the coils may be subjected, it has been found necessary to use some method of bracing or other construction to prevent distortion of the coil.

Choke coils should always be connected in the circuit between the equipment to be protected and the lightning arresters, and as near the arresters as possible. This method of installation requires that a disturbance entering a station will first come in contact with the lightning arresters and then come in contact with the choke coil, beyond which is the apparatus to be protected. The only exception to this rule is in the case of power house equipment when arresters are connected to the busbars, in which case the choke coils should be connected in the leads between the generators and the bus, or in the case of substations between the transformers and the bus.

The relative ability of a choke coil of the helical form to perform this function is, for any given number of turns per inch length of coil, determined by the total length and the square of the mean diameter of the coil. With choke coils of equal length and equal mean diameter, this varies as the square of the number of turns.

While a very small choke coil has low protective power, a very large coil will introduce excessive reactance in the line and slightly impair the regulation. It is therefore necessary to choose for any service a choke coil proportional to the needs of the apparatus to be protected. It must also have a current capacity suited to the circuit in which it is to be used, so as to avoid overheating.

The chief points for consideration in buying choke coils are diameter, number of turns, length, method of bracing and method of mounting. In Westinghouse choke coils these requirements are well balanced to meet operating conditions.

CHOKE COILS—Continued

**TYPE 191 CHOKE COIL CORES**

For Voltages Up to 1500 Direct Current

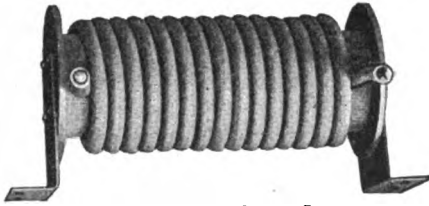


FIG. 1—TYPE 191 CHOKE COIL

Type 191 core is used on railway cars where choke coils are wanted in addition to lightning arresters. This core should be wound with a layer of trolley cable during installation, for which there will be required from 20 to 30 feet extra of cable, depending upon the size. The end turns can be fastened by passing the cable through holes in the end washers or central cylinder.

The current capacity depends upon the size of cable used.

The type 191-A core has a plain wooden drum and insulating end washers carried on sheet metal end brackets.

**Prices**

Type	APPROXIMATE WEIGHT		Style No.	List Price
	Net	Boxed		
191-A	5	8	170643	\$2 65

**Approximate Dimensions**

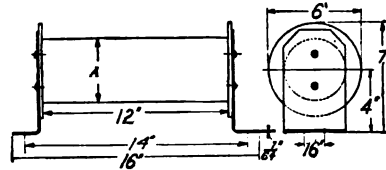


FIG. 2

**TYPE D-6 INDOOR CHOKE COILS**

For Voltages Up to 15,000 Maximum

The type D-6 choke coil, which is a suitably mounted coil of insulated wire wound on a small diameter wooden core, may be used where only a moderate degree of protection is desired.

The 15,000-volt coil consists of the standard core and winding supported by porcelain pillar insulators on the bases of which are clamped flat iron mounting castings.

This type is available in two forms up to 100 amperes capacity for two voltage classes; 5000 volts and 15,000 volts, both using the same coil, but different mountings.

The 5000-volt coil consists of the standard core and winding, with iron feet for support. This coil is adapted to mounting in any position.

**Prices**

Max. Voltage	Amps.	Mounting	APPROX. WT., LB.		Style No.	List Price
			Net	Boxed		
5000	25	Iron Feet	14	30	237782	\$11 30
			15	31	237783	12 00
			16	32	237784	15 00
5000	100	Porcelain Pillar Insulators	18	34	237785	15 90
			20	38	242087	21 90
			21	39	242088	25 00
15000	75	Insulators	22	40	242089	27 50
			24	42	242090	30 50

**APPROXIMATE DIMENSIONS**

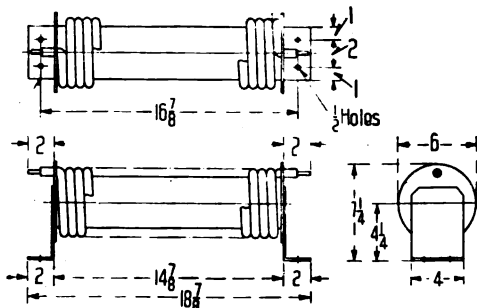


FIG. 3—TYPE D-6 WITH IRON FEET

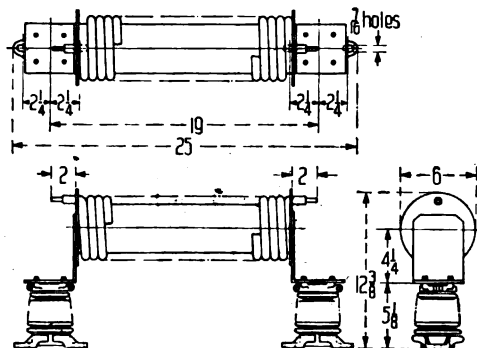


FIG. 4—TYPE D-6 WITH PORCELAIN PILLAR INSULATORS

These dimensions are for reference only. For official dimensions apply to nearest district office.

Order by Style Number

CHOKE COILS—Continued

TYPES D-9 AND D-15 MOUNTED CHOKE COILS

For Voltages Up to 154,000 Alternating Current

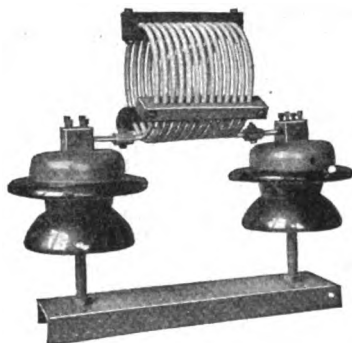


FIG 5—TYPE D-9 INDOOR OR OUTDOOR CHOKE COIL, 200 AMPERES, 37,000 VOLTS

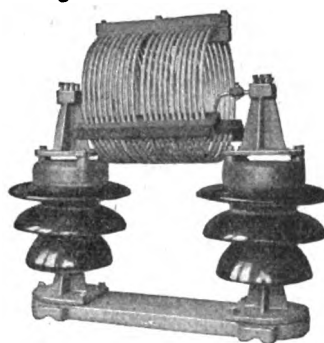


FIG. 7—TYPE D-15 INDOOR OR OUTDOOR CHOKE COIL, 200 AMPERES, 66,000 VOLTS

The types D-9 and D-15 choke coils are available for service over the entire range of standard voltages.

The type D-9, a 9-inch coil, offers sufficient protection for many installations.

The type D-15, a 15-inch coil, with consequently approximately six times the impedance of the type D-9, represents a design available for installations where maximum protection with this type of coil is desired or warranted.

**General Construction**—The coil in these types is a helix of aluminum rod in the 200 and 400-ampere capacities, and of copper in capacities of 600 amperes and above. The type D-9 coil is about 9 inches in diameter and contains 13 turns. The type D-15 coil equipped with sherardized terminals, is about 15 inches in diameter and contains 20 turns in all sizes up to 66,000 normal rated volts. Above this voltage the coils contain 30 turns. Bracing clamps are provided to rigidly separate the turns and give mechanical strength to the helix.

**Mounting**—Both types are listed for outdoor mounting up to 154,000 rated volts, and a separate line of indoor type D-9 coils is listed for voltages up to 7500 normal rated volts. All ratings of indoor or outdoor type D-9 above 66,000 volts, and all type D-15 coils are adapted to inverted mounting.

All coils are thoroughly insulated according to standard practice for this class of apparatus.

The type D-9 7500-volt indoor coils are supported by cast terminals directly on a marble base, which affords high protective value for service up to its voltage rating, and for low voltage circuits has the advantage of a more compact method of mounting.

The type D-9 indoor or outdoor coils of 15,000 maximum rated volts up to 44,000 normal rated

volts are mounted on Faradoid pin-type insulators, two of which are required for each coil. The insulators are in turn mounted on a channel iron base. These coils can be mounted only in an upright horizontal position.

The type D-9 indoor or outdoor coils of 66,000 normal rated volts, is mounted on two pin-type insulators bolted to a sheet steel base. This unit in turn is supported by a single pin-type insulator mounted on a channel-iron base.

The type D-9 indoor or outdoor coils, 110,000 normal rated volts and above, are mounted the same

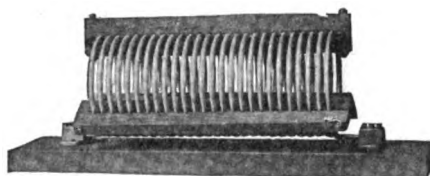


FIG. 6—TYPE D-9 7500-VOLT CHOKE COIL (INDOOR ONLY)

as outlined in the preceding paragraph, except that instead of the single pin-type insulator a built-up and bolted-together main insulator is used. This sectionalized pillar type insulator construction makes it possible to change easily the number of insulators used per column, or to replace defective porcelain units without replacing the entire column. This type is invertible by inverting all three insulators.

The type D-15 coils up to and including 66,000 normal rated volts are supported directly on two Faradoid pin-type insulators, which are bolted to a cast iron base. The type D-15 coils of 110,000 normal rated volts and above are mounted similarly on two built-up insulators mounted on a channel iron base,

PRICES—TYPE D-9 INDOOR CHOKE COILS

Style number and list price include the coil complete as described ready for connection to the line.

Maximum Voltage	Amperes	Mounting	Net	APPROX. WT.		Style No.	List Price
				LBS.	Boxed		
7500	200	Marble Base	55	110		230225	\$ 33 00
7500	400	Marble Base	63	118		230226	54 00
7500	600	Marble Base	85	140		230227	73 00
7500	800	Marble Base	105	160		236440	91 50
7500	1000	Marble Base	125	180		236441	110 00
7500	1400	Marble Base	145	205		236442	142 50
7500	1700	Marble Base	169	230		236443	175 00
7500	2000	Marble Base	203	265		236444	205 00
7500	2400	Marble Base	240	305		236445	240 00

CHOKE COILS—Continued

**TYPE D-9 INDOOR OR OUTDOOR CHOKE COILS (INVERTIBLE FOR 88,000 VOLTS AND ABOVE) WALL OR PIPE MOUNTING**

Normal	VOLTAGE		Amperes	Mounting	APPROX. WT., LBS.		Style No.	List Price
	Maximum				Net	Boxed		
.....	15000		200	Channel Iron Base	70	140	285371	\$ 42 50
.....	25000		200	Channel Iron Base	85	160	277954	50 50
.....	37000		200	Channel Iron Base	100	180	277809	58 00
44000*	.....		200	Channel Iron Base	120	205	262062	63 00
66000*	.....		200	Channel Iron Base	130	210	285374	76 50
110000†	.....		200	Channel Iron Base	195	300	315328	170 00
132000†	.....		200	Channel Iron Base	210	320	315329	185 00
154000†	.....		200	Channel Iron Base	350	500	315330	212 50
.....	15000		400	Channel Iron Base	92	160	285372	59 50
.....	25000		400	Channel Iron Base	102	180	277956	66 50
.....	37000		400	Channel Iron Base	117	200	262047	75 00
44000*	.....		400	Channel Iron Base	137	225	262055	78 00
66000*	.....		400	Channel Iron Base	147	230	285375	91 50
110000†	.....		400	Channel Iron Base	222	320	315331	186 00
132000†	.....		400	Channel Iron Base	237	340	315332	200 00
154000†	.....		400	Channel Iron Base	400	525	315333	230 00
.....	15000		600	Channel Iron Base	185	280	285373	77 50
.....	25000		600	Channel Iron Base	160	235	277955	84 50
.....	37000		600	Channel Iron Base	175	255	277807	91 50
44000*	.....		600	Channel Iron Base	195	280	277816	97 50
66000*	.....		600	Channel Iron Base	205	295	285376	110 00
110000†	.....		600	Channel Iron Base	270	375	315334	207 50
132000†	.....		600	Channel Iron Base	285	395	315335	222 50
154000†	.....		600	Channel Iron Base	385	570	315336	250 00

**TYPE D-15 INDOOR OR OUTDOOR CHOKE COILS (INVERTIBLE) WALL OR PIPE MOUNTING**

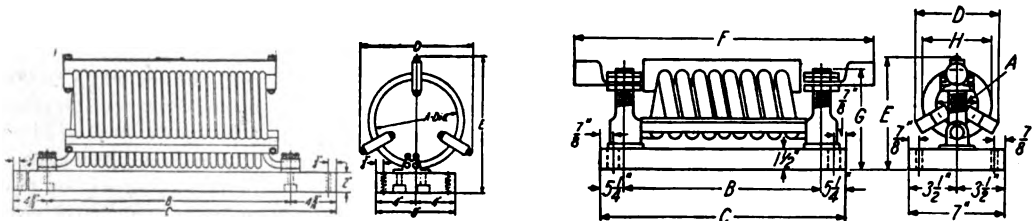
.....	25000		200	Cast Iron Base	110	241	183508	88 00
.....	37000		200	Cast Iron Base	126	258	183509	98 50
44000*	.....		200	Cast Iron Base	150	282	183510	105 00
66000*	.....		200	Cast Iron Base	180	311	183511	123 00
110000†	.....		200	Channel Iron Base	300	460	315337	312 50
132000†	.....		200	Channel Iron Base	320	480	315338	350 00
154000†	.....		200	Channel Iron Base	500	670	315339	422 50
.....	25000		400	Cast Iron Base	127	257	183512	115 00
.....	37000		400	Cast Iron Base	143	275	183513	128 00
44000*	.....		400	Cast Iron Base	167	298	183514	134 00
66000*	.....		400	Cast Iron Base	197	328	183515	154 00
110000†	.....		400	Channel Iron Base	323	483	315340	347 50
132000†	.....		400	Channel Iron Base	343	503	315341	390 00
154000†	.....		400	Channel Iron Base	550	700	315342	460 00
.....	25000		600	Cast Iron Base	187	330	183516	154 00
.....	37000		600	Cast Iron Base	233	376	223412	166 00
44000*	.....		600	Cast Iron Base	257	400	223413	174 00
66000*	.....		600	Cast Iron Base	290	430	223414	192 00
110000†	.....		600	Channel Iron Base	410	565	315343	470 00
132000†	.....		600	Channel Iron Base	430	588	315344	500 00
154000†	.....		600	Channel Iron Base	600	790	315345	540 00
.....	25000		800	Cast Iron Base	318	458	183517†	227 50
.....	25000		1000	Cast Iron Base	405	555	183518†	332 50

\*Choke coils rated at 44,000 normal voltage have a maximum rating of 50,000 volts and choke coils rated at 66,000 normal voltage have a maximum rating of 73,000 volts. These coils may be applied up to maximum rating.

†Choke coils rated at 110,000 normal voltage or higher may be applied on systems having a maximum voltage not exceeding 5 per cent above rated voltage.

‡On account of the considerable weight of these coils they should be mounted in a horizontal position. For other mounting, either vertical or ceiling mounting, special coils will be supplied.

**APPROXIMATE DIMENSIONS**  
Type D-9 Indoor 7500-Volt Choke Coils



Amperes	Fig.	DIMENSIONS IN INCHES							
		A	B	C	D	E	F	G	H
200	8	8 3/4	18 1/2	27 1/2	10 3/4	13 3/4	10	...	...
400-600	8	8 3/4	23 1/2	32 1/2	11 1/2	14 3/4	12 3/4	...	...
800	9	8	16 1/2	27	11 1/2	13 3/4	24 1/4	5 3/4	9 3/4
1000	9	8	16 1/2	27	12	16 1/4	24	6	10
1400	9	8	19 1/2	30	12 1/2	14 1/4	27	6	10 1/2
1700	9	8	19 1/2	30	12 1/2	14 3/4	27 3/4	8 1/4	10 1/2
2000	9	8	23 1/2	34	12 3/4	14 3/4	31 3/4	8 3/4	10 3/4
2400	9	8	23 1/2	34	12 3/4	14 3/4	31 3/4	9 3/4	11

These dimensions are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number



CHOKE COILS—Continued

TYPE D-9 INDOOR OR OUTDOOR CHOKE COILS

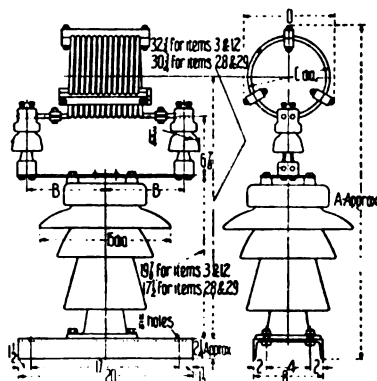


FIG. 10

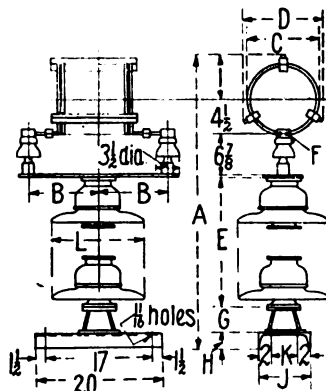


FIG. 11

Fig. No.	Amps.	Volts	DIMENSIONS IN INCHES												
			A	B	C	D	E	F	G	H	I	J	K	L	
10	200	49000-72600	36 1/4	9	9 1/2	10 3/4	...	...	...	...	...	...	...	...	...
10	400-600	49000-72600	37 1/4	11	9 1/2	11 1/4	...	...	...	...	...	...	...	...	...
11	200	110000	58	9	9 1/2	10 3/4	35 1/4	2 1/2	2 1/2	6	8	4	15	...	
11	200	132000	67 1/4	9	9 1/2	10 3/4	45	1 1/2	2 1/2	6	12	8	16 1/2	...	
11	200	154000	104 1/4	9	9 1/2	10 3/4	80 1/4	4	2 1/2	6	8	4	14 1/2	...	
11	400-600	110000*	58 1/2	11	9 1/2	11 1/4	35 1/4	2 1/2	2 1/2	6 1/2	8	4	15	...	
11	400-600	132000*	67 1/4	11	9 1/2	11 1/4	45	1 1/2	2 1/2	6 1/2	12	8	16 1/2	...	
11	400-600	154000	104 1/4	9	9 1/2	10 3/4	80 1/4	4	2 1/2	6	8	4	14 1/2	...	

\*These coils have insulators of the type shown in Fig. 14.

TYPE D-9 INVERTIBLE CHOKE COILS

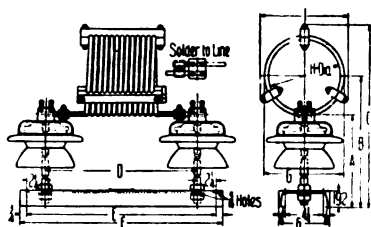


FIG. 12

Fig. No.	Amps.	Volts	DIMENSIONS IN INCHES								
			A	B	C	D	E	F	G	H	I
12	200	15000-25000	13 1/4	18 1/4	24 1/4	18	22 1/4	24 9/16	9	10 1/4	
12	400-600	15000-25000	13 1/4	18 1/4	24 1/4	22	26 1/4	28 9/16	9	11 1/4	
12	200	25000-37000	14 1/4	19	24 1/4	18	22 1/4	24 9/16	10 1/4	10 1/4	
12	400-600	25000-37000	14 1/4	19 1/4	25 1/4	22	26 1/4	28 9/16	10 1/4	11 1/4	
12	200	10000-15000	9	13 1/4	19 1/4	18	22 1/4	24 9/16	7	10 1/4	
12	400-600	10000-15000	9 1/4	13 1/4	20	22	26 1/4	28 9/16	7	11 1/4	
12	200	37000-50000	17	21 1/4	27 1/4	18	22 1/4	24 9/16	12	10 1/4	
12	400-600	37000-50000	17 1/4	22	29 1/4	22	26 1/4	28 9/16	12	11 1/4	

TYPE D-15 INDOOR OR OUTDOOR CHOKE COILS—WALL OR PIPE MOUNTING

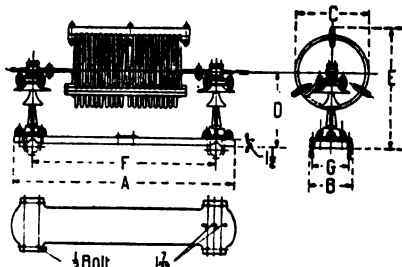


FIG. 13

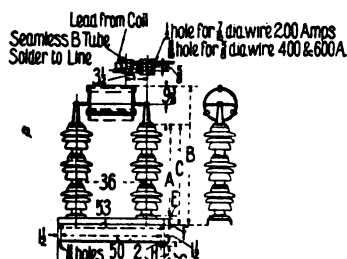


FIG. 14

Fig. No.	Amperes	VOLTAGE		DIMENSIONS IN INCHES							
		Normal	Maximum	A	B	C	D	E	F	G	H
13	200	...	25000	32 1/4	9 1/2	15 1/2	18 1/4	27 1/4	24	8 1/2	...
13	200	...	37000	33 1/4	10 3/4	15 1/2	21 1/4	31 1/4	24	9	...
13	200	44000*	...	33 1/4	10 3/4	15 1/2	25 1/4	34 1/4	24	9	...
13	200	66000*	...	33 1/4	10 3/4	15 1/2	27	36 1/4	24	9	...
13	400-600	...	25000	32 1/4	9 1/2	15 1/2	18 1/4	27 1/4	24	8 1/2	...
13	400-600	...	37000	33 1/4	10 3/4	15 1/2	21 1/4	31 1/4	24	9	...
13	400-600	44000*	...	33 1/4	10 3/4	15 1/2	25 1/4	34 1/4	24	9	...
13	400-600	66000*	...	33 1/4	10 3/4	15 1/2	27	36 1/4	24	9	...
13	800	...	25000	46 1/4	9 1/2	15 1/2	19 1/4	28 1/4	38 1/4	8 1/2	...
13	1000	...	25000	51	9 1/2	16	18 1/4	27 1/4	42 1/4	8 1/2	...
14	200-400-600	110000	...	35 1/4	50 1/4	40 1/4	9 1/2	2 1/2	2 1/2	8	4
14	200-400-600	132000	...	45	68 1/4	49 1/4	9 1/2	1 1/2	2 1/2	12	8
14	200-400-600	154000*	...	80 1/4	104 1/4	86 1/4	8 3/4	4	2 1/2	8	4

\*These coils have insulators as shown in Fig. 11.

Choke coils rated at 44,000 normal voltage have a maximum rating of 50,000 volts and choke coils rated at 66,000 normal voltage have a maximum rating of 73,000 volts. These coils may be applied up to their maximum rating. Choke coils rated at 88,000 normal voltage or higher may be applied on systems having a maximum voltage not exceeding 5 per cent above rated voltage.

These dimensions are for reference only. For official dimensions apply at the nearest district office.

CHOKE COILS—Continued

SUSPENSION CHOKE COILS

For All Voltages up to 220,000 Normal, Alternating-Current



FIG. 15—TYPE D-6 LINE SUSPENSION CHOKE COIL

Line-suspension type choke coils have been developed to meet the demand for a choke coil that can be inserted directly in the transmission-line wire or in the station wiring and held in position by the tension of the line or station wires. As no insulators are required to support this choke coil, it can be installed in either a vertical or horizontal position and can be utilized very effectively in power and sub-station lay-outs. Terminals to accommodate the conductors are provided at each end of the coil. A strain insulator is so arranged within the coil at its axis, that it assumes the mechanical tension transmitted from the conductors. No mechanical tension reaches the turns of the choke coil proper. An eye fastened to the end bracing and strain insulator provides a convenient means of supporting the coil. As the coils are entirely symmetrical it is

immaterial which end is connected to the line or to the apparatus.

The line suspension type D-6 choke coil is made up of 20 turns of copper-clad steel wire. The coil has a mean diameter of four and one-sixth inches, two clamping strips, and a strain insulator.

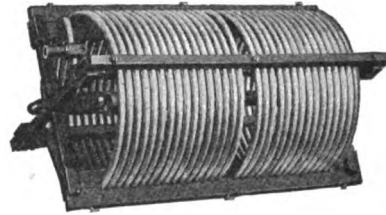


FIG. 16—D-15 LINE SUSPENSION CHOKE COIL

The line suspension types D-9 and D-15 choke coils are practically the same as the mounted coils in number of turns, diameter and material.

Style number and list price include the coil complete as described ready for connection to the line.

PRICES

Line-Suspension Indoor or Outdoor Choke Coils for All Voltages Up to 220,000 Volts Normal

Amperes	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
100	18½	32½	356392	\$ 20 00
			<b>Type D-6</b>	
			<b>Type D-9</b>	
200	33	93	236447	48 00
400	47	111	236449	77 00
600	106	136	236450	107 00
			<b>Type D-15</b>	
200	45	105	121727	80 00
400	66	130	164463	116 00
600	167	198	236446	150 00

OUTLINE DIMENSIONS IN INCHES

TYPE D-6 CHOKE COIL

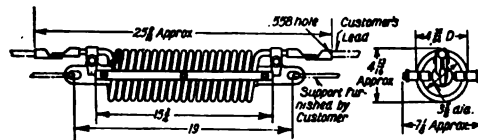


FIG. 17

TYPE D-9 AND D-15 CHOKE COILS

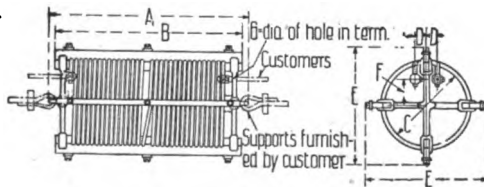


FIG. 18

		DIMENSIONS IN INCHES						
Type	Amperes	A	B	C	D	E	F	G
D- 9	200	27 3/4	25 1/4	8 1/4	1 1/4	12 3/4	1 3/4	1 1/4
D- 9	400-600	32 1/4	29 3/8	8 3/8	1 1/2	12 3/4	1 7/8	1 1/2
D-15	200	27 3/8	25 1/8	14 1/8	1 1/2	18 3/4	4 1/2	1 1/2
D-15	400-600	32 3/4	29 3/8	14 3/8	2	18 3/4	4	1 1/2

## GROUND CONNECTIONS

### Connection to Existing Grounds

Direct connection to an underground pipe system (such as a city water main), furnishes excellent ground, because of the great surface of pipe in contact with the moist earth and the maximum number of alternative paths for the discharge. A supplementary ground line should always be connected to the structural steel framework of the station, and to any nearby trolley rails. In water-power plants the ground should always include a connection to the pipe line or penstock and to the case or frame of the apparatus to be protected.

### Methods for Making Grounds

**Buried Plate**—A good ground connection for a bank of station arresters may be made as detailed in Fig. 1, in the following manner:

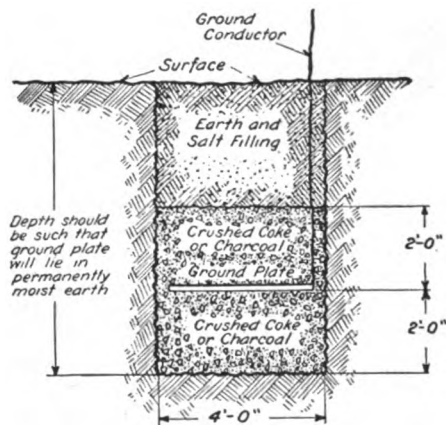


FIG. 1—METHOD OF MAKING GROUND CONNECTION

**First**, dig a hole four feet square as near the arrester as possible until permanently damp earth has been reached.

**Second**, cover the bottom of this hole to a depth of two feet with crushed coke or charcoal (about pea size).

**Third**, over this lay 10 sq. ft. of tinned copper plate.

**Fourth**, solder or rivet the ground wire, preferably copper strip, securely across the entire length of the ground plate.

**Fifth**, cover the ground plate with two feet of crushed coke or charcoal.

**Sixth**, fill the hole with earth, with plenty of common salt sprinkled in it, using running water to settle it.

**Iron Pipe Ground**—A ground that is simple and very effective may be obtained by driving three-quarter-inch galvanized-iron pipe into the earth. The pipes should each have a galvanized-iron point and a brass cap with a lug for soldering, (malleable point, Style No. 157169, brass cap Style No. 157170). The pipes should be 8 to 10 feet long and should be driven into earth until about 6 inches is exposed. For station arresters a multiple-pipe ground should be used, the pipes spaced approx-

imately 8 to 10 feet apart. An arrangement of 7 pipes in parallel is very good for this purpose; they may be arranged as shown in Fig. 2, an arrangement which is economical in space and wire. A single-pipe ground or any pipe of a group should have a resistance to an adjacent water pipe of not more than 15 to 30 ohms; two pipes in parallel not more than  $7\frac{1}{2}$  to 15 ohms; three pipes in parallel not more than 5 to 10 ohms, etc.

**Proper Soil for Ground**—The above methods of making a ground connection are simple, cheap and have been found to be very effective; yet if not made in proper soil they will prove of little value. Clay even when wet, rock, sand, gravel, dry earth, and pure water are **not** suitable materials in which to place a lightning-arrester ground. Rich soil is the best. This soil should be damp and should contain some solution of acid, alkali, or salt; salt water is excellent for this purpose.

To replace the salt solution washed out of the soil, sprinkle plenty of crystal salt or common salt around the pipe, or better yet, place it in moist earth around the pipes just beneath the surface.

**Grounding in Streams**—When a mountain stream is conveniently near it is not uncommon to throw the ground plate into the stream. The practice results in poor contact, owing to the high resistance of pure water and the rocky bottom of the stream.

**Ground Conductor**—For the conductor between the arrester and the ground connection, either strap copper or copper tubing should be used. It is important that a conductor having the greatest possible superficial area be used, inasmuch as high frequency discharges are carried almost wholly on the surface of their conductor. Strap copper having a section say  $\frac{1}{2}$  by  $1\frac{1}{2}$  inches makes a good conductor for the average condition. Such a ground conductor may be fastened directly to the station structure with wood-

FIG. 2—ARRANGEMENT OF MULTIPLE PIPE GROUND

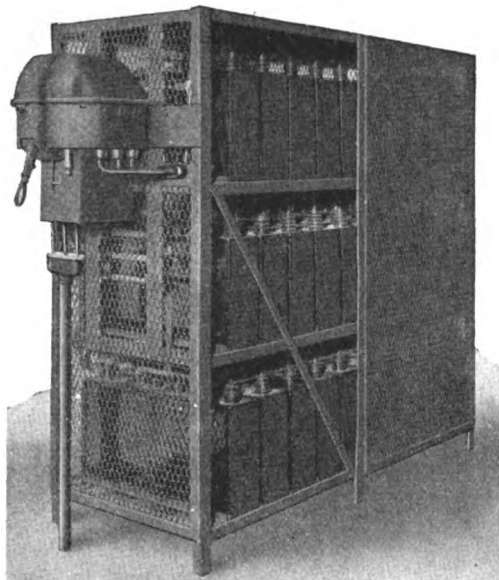
Do not run the ground lead of a lightning arrester in an iron pipe because the choking effect of the pipe at the high frequency of lightning will limit the freedom of discharge. The ground connection of a lightning arrester should be run as direct as possible, avoiding unnecessary bends or loops to reduce to a minimum the inductance of the circuit.

**Record of Ground**—When an earth connection is arranged it is an excellent plan to make an accurate record of its location, construction, and condition, so that later it may be easily accessible for inspection.

**Inspection**—Earth connections or "grounds" should be periodically inspected, examined, and tested for resistance at least once a year to ascertain their condition.

## TYPE LD STATIC CONDENSERS

For Power Factor Correction



120 KV-A., 3-PHASE, 2300-VOLT TYPE LD  
STATIC CONDENSER COMPLETE WITH TYPE F-10 OIL CIRCUIT-  
BREAKER (One section of grill work removed to show assembly  
of units)

A relatively high power factor is necessary for the economical operation of generating systems.

The ever increasing use of induction motors and other inductive apparatus has developed a need for corrective devices.

Synchronous condensers have played an important part in this field but their use is somewhat restricted to plants where they are needed in large sizes and where the attention necessary to rotating apparatus is not a serious factor.

In order to meet the demand for corrective devices for smaller loads and to eliminate the high cost of installation and attendance, the static condenser has been developed.

Static condensers for 2300-volt, three-phase service, consist of a number of 2 kv-a. units assembled in angle iron frames, with discharge resistances and an automatic oil circuit-breaker. The connections on the bus bars are removable for cutting units in or out to change the corrective capacity.

The discharge resistances remain in parallel with the condensers at all times, discharging them in a short time after the oil circuit-breaker is opened thus protecting the operator from stored charges.

The frames are completely enclosed with expanded metal making them safe without additional guards.

For two-phase 2300-volt circuits, the units are designed for a terminal voltage of 2300 and are connected directly across the phases.

Individual units are designed for either 1328 or 2300 volts and therefore are applicable in various combinations to practically all standard distribution circuits.

For other voltages such as 220, 440, and 550 transformers are used to step the voltage up for the condenser as it is not economical to design the units for low voltages.

### Advantages of Static Condensers

Losses in the 2300-volt condensers are less than 0.5 per cent and in the lower voltage equipments using transformers, less than  $3\frac{1}{2}$  per cent of the total.

No attendance is required.

No special foundation required.

No moving or wearing parts requiring replacement.

Condenser does not "drop off" the line should voltage fail for a short time.

Noiseless operation.

### Description of Units

The units consist of alternate layers of metal foil and paper, assembled in a sheet steel case with leads brought out through special oil tight bushings. The stacked units are treated by a special vacuum process to remove moisture and air and when assembly is completed they are hermetically sealed.

TYPE LD STATIC CONDENSERS—Continued

For a given kv-a. the size and cost increase rapidly with increase in thickness of insulation and consequent decrease in working stress. Insulation stresses have been adopted that place the apparatus on the same basis as to reliability and life as other electrical equipment and the size of the complete outfit has been held down by compact frame assembly. This dielectric factor of safety eliminates the necessity of protecting the units against over-voltage by fusing individual units.

**Disadvantages of Low-Power-Factor Operation**

(1) **Increased losses** in generators, exciters, distribution lines, transformers and in consumers plant.

**Example**—In a system working at 70 per cent power factor, the losses would be twice as great as if the same system were working at unity power factor.

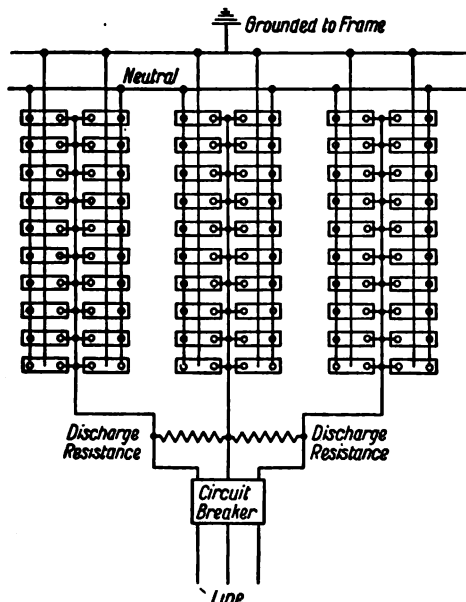
(2) **Increased cost** of generators, transformers, cables, etc., or reduced kw. capacity of same.

**Example**—If the cables and conductors in the above system were increased to keep the losses at 70 per cent power factor the same as they were when the power factor was unity the cross sectional area would have to be doubled.

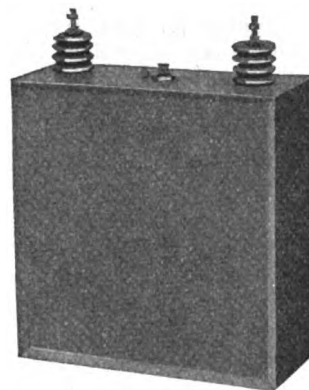
Assume a single-phase motor load of 75 kw. at 550 volts, the currents at various power factors would be:

$$I = \frac{\text{Watts}}{E (\% \text{ P. F.})}$$

P. F.	100%	90%	80%	70%	60%	50%
Current in Circuit	136.3	151.5	170.5	195	228	273
Kv-a.	75	83	94	107	125	150



SCHEMATIC DIAGRAM OF CONNECTIONS FOR 3-PHASE 2300-VOLT SERVICE, STAR-CONNECTED



TYPE LD INDIVIDUAL STATIC CONDENSER UNIT

(3) **Poor voltage regulation.**

**Example**—The preceding table shows that there would be considerable line drop at 50 per cent power factor that would necessitate impressing over-voltage at the supply end and the regulation would be poor. The regulation of transformers is approximately 1 per cent at unity power factor and 3 per cent at 70 per cent power factor.

(4) **Penalties for low power factor.**

The disadvantages of low power factor are so appreciated that the majority of power companies charge higher rates for energy when delivered at low power factors.

**Application Data**

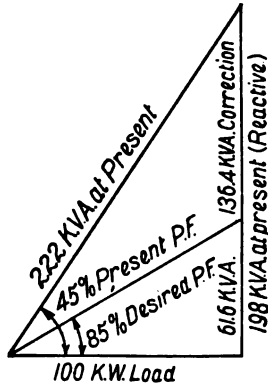
The kv-a. of static condensers required to correct any given power factor to any desired power factor is entirely dependent on the kw. load in the plant, inasmuch as a condenser which would correct a 100 kw. load from 50 per cent power factor to unity power factor would only increase the power factor to 76 per cent if the kw. load became 200.

For instance, in the case of an industrial plant whose average load is 100 kw. and whose average power factor is 45 per cent. The power rates are such that a penalty is imposed for power factors below 85 per cent and the penalty is sufficient to warrant the installation of power factor correcting apparatus; that is, the annual saving by correcting the power factor should more than offset the interest, up-keep and depreciation of such an equipment. In some cases it may prove profitable to correct the power factor up to unity, but for the present case all that is desired is to correct the power factor to 85 per cent.

At 45 per cent power factor the total kv-a. is 222 and accordingly the power transformer must be sufficiently large to take care of it. The reactive or wattless kv-a. is the vector difference between 222 and 100 or 198 kv-a. At 85 per cent power factor

TYPE LD STATIC CONDENSERS—Continued

the total kv-a. will be 117.8, which shows that the customer's transformer capacity can be practically cut in half. The wattless kv-a. in this case will be 61.6 so that the necessary corrective effect to change the load from 45 per cent to 85 per cent power factor will be 198 minus 61.6 or 136.4 kv-a. The proper size of static condenser would, therefore, be one of a 150 kv-a. rating. Obviously the new power transformer rating should not be less than 150 kv-a. which is the continuous demand of the static condenser alone.



Present load = 100 kw. at 45 per cent power factor  
 Desired power factor = 85 per cent.  
 $\text{Present kv-a.} = \frac{100}{.45} = 222 \text{ kv-a.}$   
 $\text{Present reactive kv-a.} = \sqrt{222^2 - 100^2} = 198 \text{ kv-a.}$   
 $\text{Kv-a. at desired power factor} = \frac{100}{.85} = 117.8 \text{ kv-a.}$   
 $\text{Reactive kv-a. at desired power factor} = \sqrt{117.8^2 - 100^2} = 61.6 \text{ kv-a.}$   
 Corrective effect needed = 198 - 61.6 = 136.4  
 Size of standard condenser = 150 kv-a.

It quite often happens that the customer meters his load on the high-voltage side of the power transformers and if the voltage on the high side is 2300 volts the condensers can be connected directly to this line between the metering equipment and the power transformers. In this case, however, the power transformers will carry the same kv-a. as before.

Information Required for the Application of Static Condensers

1. Present load in kw.
2. Present power factor.
3. Desired power factor.
4. Actual average voltage in plant.
5. Maximum sustained voltage for periods of at least one-half hour.
6. Frequency and number of phases.
7. Rating of the power transformers.
8. Is customer's plant at the end of a long feeder or is it located near the center of an industrial district?
9. Is any future increase over the present load contemplated and if so how much?
10. Are there any machines, such as compressors, in the plant to which synchronous motors can be properly applied?
11. Does the plant operate at normal capacity twenty-four hours a day? If not what are the load conditions during the night?
12. Is the customer's load subject to seasonal changes and if so to what extent?

PRICES

Three-Phase 60-Cycle Equipments

Kv-a. Capacity	LIST PRICES	
	Direct on 2300 Volts	With 2-winding Transformers† 220-440-550- Volts
30	\$1790 00	\$1900 00
60	2710 00	3280 00
90	3500 00	4680 00
120	4170 00	5740 00
150	4975 00	6830 00
180	5750 00	7620 00
240	7570 00	9340 00
300	9250 00	10900 00

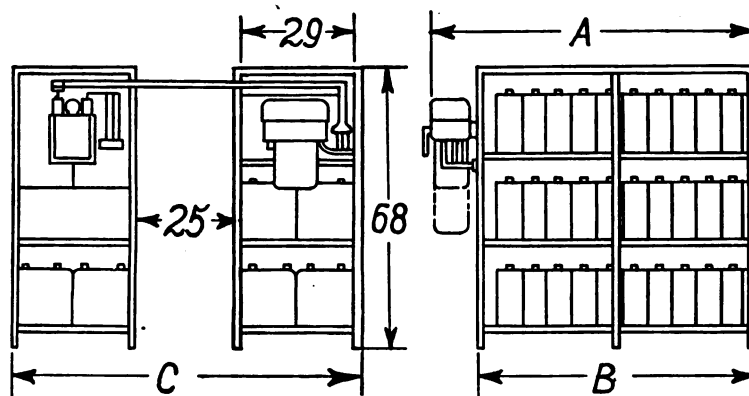
WEIGHTS, DIMENSIONS AND LOSSES OF STATIC CONDENSERS

Not Including Transformers

Kv-a*	Voltage	Number of Frames	Phases	DIMENSIONS IN INCHES			Net Wt. Lbs.	Condenser Loss in Watts
				A	B	C		
30	2300	1	3	39	26 1/2	...	1345	100
60	2300	1	3	51	38 1/2	...	2275	200
90	2300	1	3	69	56 1/2	...	3250	300
120	2300	1	3	81	68 1/2	...	4191	400
150	2300	2	3	81	68 1/2	83	5536	500
180	2300	2	3	81	68 1/2	83	6466	600
240	2300	2	3	81	68 1/2	83	8382	800
300	2300	3	3	81	68 1/2	128	10657	1000

\*For capacities smaller than the above sizes condenser units may be left out of the three-phase units in groups of three units or six kv-a. Large units of 500 kv-a. or more are made up of multiples of the standard units.  
 †The transformers listed are standard two-winding transformers. Their reliability and safety of insulation warrants their use rather than auto transformers.

TYPE LD STATIC CONDENSERS—Continued

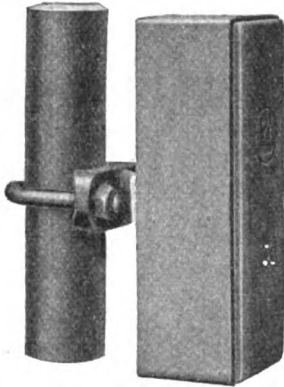


WEIGHTS AND DIMENSIONS OF TRANSFORMERS

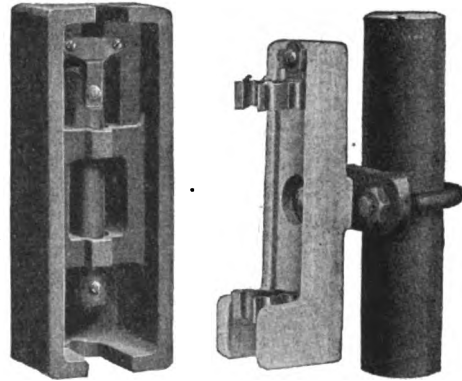
Cond. Kv.-a.	Trans. Kv.-a.	Power Circuit Voltage	Transformer Net Wt., Lbs.	Oil Net Wt., Lbs.	DIMENSIONS IN INCHES		
					Height	Width	Depth
30	33	220	1290	252	40 3/4	35 1/2	26 3/4
30	33	440	1290	252	40 3/4	35 1/2	26 3/4
30	33	550	1290	252	40 3/4	35 1/2	26 3/4
60	66	220	1980	434	40 3/4	45	29 1/2
60	66	440	1980	434	40 3/4	45	29 1/2
60	66	550	1980	434	40 3/4	45	29 1/2
90	99	220	2155	700	54 3/4	45	29 1/2
90	99	440	2155	700	54 3/4	45	29 1/2
90	99	550	2155	700	54 3/4	45	29 1/2
120	132	220	2685	980	58 1/4	51 1/4	32 3/4
120	132	440	2685	980	58 1/4	51 1/4	32 3/4
120	132	550	2685	980	58 1/4	51 1/4	32 3/4
150	165	220	2710	1120	62 1/4	51 1/4	32 3/4
150	165	440	2710	1120	62 1/4	51 1/4	32 3/4
150	165	550	2710	1120	62 1/4	51 1/4	32 3/4
180	198	220	3200	1266	69 1/4	51 1/4	32 3/4
180	198	440	3200	1266	69 1/4	51 1/4	32 3/4
180	198	550	3200	1266	69 1/4	51 1/4	32 3/4
240	264	220	5300	2150	84	60	40
240	264	440	5300	2150	84	60	40
240	264	550	5300	2150	84	60	40
300	330	220	5850	3100	105	60	40
300	330	440	5850	3100	105	60	40
300	330	550	5850	3100	105	60	40

# POTENTIAL TRANSFORMER FUSES AND FUSE BLOCKS

## Enclosed Cartridge Type for Indoor Service



2500-VOLT FUSE BLOCK WITH COVER AND FUSE IN PLACE



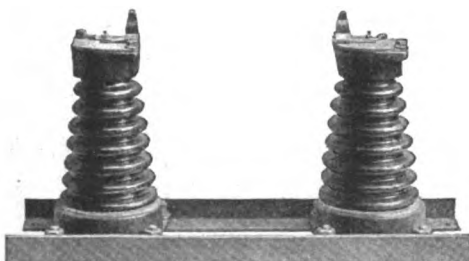
2500-VOLT FUSE BLOCK, OPEN TO SHOW METHOD OF MOUNTING FUSE IN COVER

### Application

Potential transformer fuses and fuse blocks are supplied for the protection of indoor potential transformers. They may, however, be used to protect other circuits where the normal current does not exceed one-half an ampere. The fuses may be applied without preventive resistances in such locations where the maximum short-circuit current does not exceed the interrupting capacity given in the table. When a preventive resistance is used the short-circuit current will be limited, irrespective of the power back of the fuse, to a value within the interrupting capacity of the fuse. For 15,000 and 25,000-volt service the same fuse is used. A different preventive resistance to limit the current and a different fuse base is used for either the 15,000 or 25,000-volt installations.

### Distinctive Features

- High interrupting capacity.
- Strong fibre casing treated to be non-absorbent.
- Effective arc-quenching filler.
- Proper venting of gases.
- 2500-volt base has insulated safety-first cover.
- Corrugated pillar type insulators on high voltage bases.



FUSE BASE FOR VOLTAGES FROM 2500 TO 25,000

### Construction

These fuses are designed especially for the protection of potential transformers. Their interrupting capacity is such that when properly applied with preventive resistances they will give full protection.

The 2500-volt fuse base is provided with a cover of moulded insulation which holds the fuse and provides for the safe handling of the fuse.

The higher voltage bases use corrugated post type insulators of the same type as used on the type S disconnecting switches.

### Interrupting Capacity

Style No.	Voltage	Maximum Interrupting Capacity in Amperes at Rated Volts
282431	2500	1700
282430	7500	1000
282429	15000	250
282428	25000	100

\*See pages of this Catalogue listing 600-volt enclosed fuses for interrupting capacity.

### Prices

Style number and list price of the fuse block include the block complete without fuses. Fuses should be ordered separately.

#### Fuse Blocks

Volts	No. of Poles	Connection	For Use With Fuse	Net Wt. Each Lbs.	Style Number	List Price
2500	1	Front	282431	3	385022	\$17 75
7500	1	Front	282430	25	385023	20 00
7500	1	One Stud Front	282430	25	385024	24 50
		One Stud Rear				
15000	1	Front	282429	30	385025	20 00
15000	1	One Stud Front	282429	30	385026	24 50
		One Stud Rear				
25000	1	Front	282428	50	385027	29 00

#### Fuses

Volts	Standard Package Quantity	Carton Per Quantity	Net Wt. Carton Lbs.*	Style Number	List Price Each
2500	100	5	2 1/4	282431	\$2 20
7500	25	5	2	282430	2 20
15000	25	5	2	282429	2 20
25000	25	5	2	282428	2 20

\*For shipping weight add ten per cent (10%) when shipped in quantities.



POTENTIAL TRANSFORMER FUSES AND FUSE BLOCKS—Continued

The following style numbers of fuse blocks and fuses are of the old design, formerly listed, and are listed in the following table simply for repair work for existing installations.

FUSE BLOCKS

Volts	No. of Poles	Connection	For Use With Fuse	Net Wt. Each Lbs.	Style Number	List Price
600	2	Front	37185	3	56359†	\$ 3 00
2500	2	Front	32304	4½	117375‡	5 00
7500	1	Front	37218	19	55382	11 00
15000	1	Front	37288	31	55383	13 00
25000	1	Front	42970	40	58070	16 00

FUSES

Volts	Standard Am-peres	Carton Package Quantity	Net Wt. Carton Lb.*	Per Carton	Style Number	List Price Each
2500	½	100	5	½	32304	\$ 70
7500	½	25	5	2	37218	1 95
15000	½	25	5	2	37288	3 80
25000	½	25	5	3	42970	5 30

\*For shipping weight add ten per cent (10%) when shipped in quantities.

†Style No. 56359 is adapted to direct mounting on all standard size Westinghouse transformers within its voltage limit except 25 cycle transformers S Nos. 10352, 10333 and 3092, for mounting on which auxiliary mounting straps S No. 229104 are required. This mounting strap will be furnished at no additional price if ordered at time fuse block is ordered.

‡Style No. 117375 is adapted to direct mounting on the 1000 and 2000 volt, type S, 60 cycle, standard Westinghouse transformers, but requires auxiliary mounting strap S No. 168041 for mounting on 1000 and 2000 volt, 25 cycle transformers, S No. 30055 and S No. 30056. This mounting bracket will be supplied without extra charge when ordered with the fuse block.

Fuse tongs for handling the high voltage fuses are listed under the heading of "Enclosed Cartridge Fuses up to 25,000 Volts."

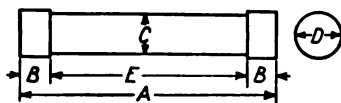


FIG. 1

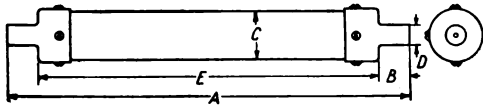


FIG. 2

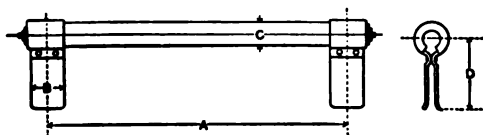


FIG. 3

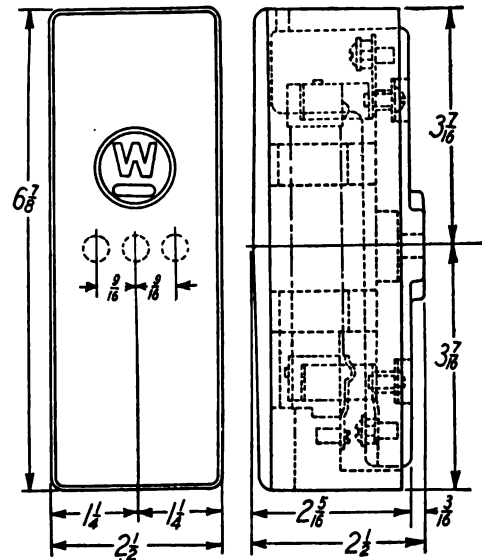


FIG. 4

FUSES

Voltage	Style No.	Fig.	DIMENSIONS IN INCHES				
			A	B	C	D	E
2500	282431	2	4½	½	¾	.816	3¾
2500	32304	1	5½	¾	¾	1.067	4½
7500	282430	2	9½	¾	1	1.067	7½
7500	37218	3	13	¾	¾	1½	10½
15000	282429	2	12½	¾	1½	1½	10½
15000	37288	3	18	¾	¾	1½	10½
25000	282429	2	12½	¾	1½	1½	10½
25000	42970	3	20	¾	1	1½	10½

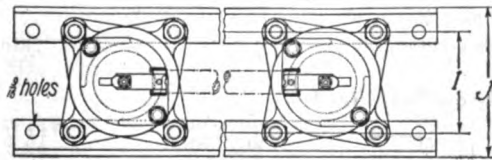


FIG. 5

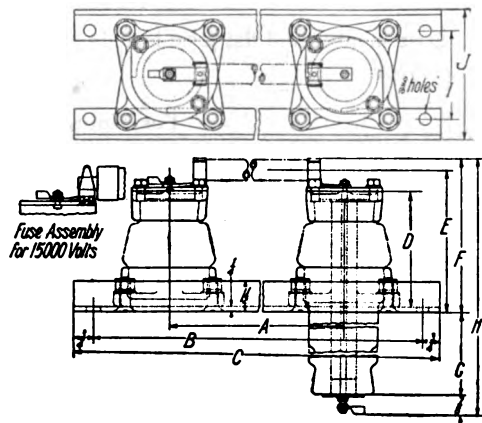


FIG. 6

FUSE BLOCKS

Voltage	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E	F	G	H	I	J
7500	5	11½	19½	20½	5½	6½	7½	..	4½	4½	6½
7500	6	11½	19½	20½	5½	6½	7½	4½	12½	4½	6½
15000	5	14½	22	23½	7½	8½	9½	..	4½	4½	6½
15000	6	14½	22	23½	7½	8½	9½	6½	16½	4½	6½
25000	5	14½	22½	24½	10½	11½	12½	..	..	5½	7½

These dimensions are for reference only. For official dimensions apply to nearest district office.

## CURRENT-LIMITING RESISTORS FOR POTENTIAL TRANSFORMER FUSES

The resistors listed herein are designed to be placed in series (that is, one per wire) with potential transformer fuses only when the kv-a. rating of the station or power source exceeds the interrupting capacity of the fuses (see pages of this catalog on "Potential Transformer Fuses"). They should preferably be installed just ahead of the fuse, between the fuse and the bus. These limiting resistors restrict the power that the fuses may be called upon to interrupt in the case of a short-circuit or overload to such a value that the fuses will safely interrupt the circuit. They are so selected that they will not materially increase errors in meter reading.

The resistors are in rod form and have sprayed copper terminals on each end for connecting in the mounting clips. The rod is enclosed in a micarta-tube holder which is clamped at the middle to an insulator cap.

Two types of mounting are listed. One type (Fig. 1) is intended for mounting directly on the bus, and the other type (Fig. 2) is intended for use when the resistor is supported on a standard Westinghouse

pillar-type insulator. In either case, the resistor is enclosed within a micarta insulating tube.

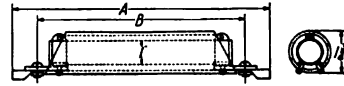


FIG. 1

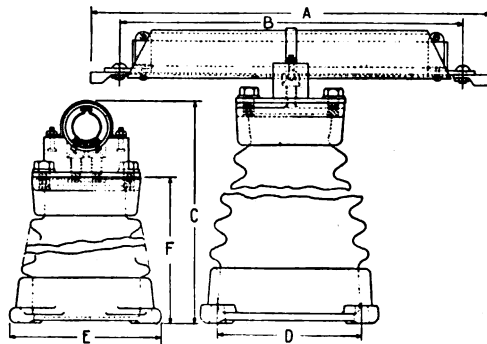


FIG. 2

### RATINGS AND PRICES

#### Resistors Without Mountings

Style number and list price include resistor only. One resistor is required for each fuse.

VOLTAGE		Resistance Ohms	Approx. Shipping Wt., Lbs.	Style No.	List Price
Over	To				
600	2500	18-22	2	266565	\$2 75
2500	7000	90-110	2	266412	4 00
7000	15000	180-220	3	276669	4 50
15000	25000	300-500	3	276671	5 00

#### Resistors With Mountings

Style number and list price include resistor with mounting as shown.

VOLTAGE		Resistance Ohms	Approx. Shipping Wt., Lbs.	Style No.	List Price
Over	To				
<b>For Mounting Directly on Bus, Fig. 1</b>					
600	2500	18-22	8	267778	\$11 75
2500	7000	90-110	8	267780	15 50
7000	15000	180-220	10	267781	16 00
15000	25000	300-500	10	267782	21 00
<b>For Separate Mounting with Pillar-Type Insulator, Fig. 2</b>					
600	2500	18-22	15	265028	20 00
2500	7000	90-110	15	265029	25 00
7000	15000	180-220	17	265030	25 50
15000	25000	300-500	17	265031	34 00

### OUTLINE DIMENSIONS

Resistor	STYLE No.		DIMENSIONS IN INCHES, FIG. 1					
	Unit Complete for Mounting on Bus-Bar	Unit Complete with Insulator	A	B	C	D	E	F
266565	267778	265028	7 1/4	5 1/4	8 1/4	4 1/4	5 1/2	5 1/4
266412	267780	265029	9 1/4	6 1/4	8 1/4	4 1/4	5 1/2	5 1/4
276669	267781	265030	11 1/4	9 1/4	10 1/4	4 1/4	5 1/2	7 1/4
276671	267782	265031	16 1/4	15 1/4	13 1/4	5 1/4	6 1/4	10 1/4

## DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES

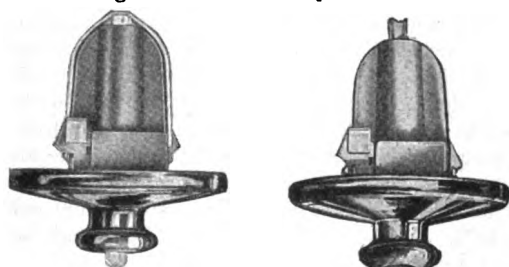
### Single-Pole—For Outdoor Mounting PLUG-TYPE

For Use on Circuits Up To 5000 Volts

#### Application

These fuse blocks are designed for use on circuits not exceeding 30 amperes and 5000 volts and of moderate capacity. Two forms are supplied, one for 2500 volts maximum, and the other for 5000 volts maximum. With the exception of the contact clips and mounting screws, all parts are of porcelain. They are entirely weather proof and are readily mounted on a cross arm or on any location convenient to the transformer by screws placed through the holes in the side of the block in the case of the 2500-volt block, or by a mounting strap around the block in the case of the 5000-volt block.

The block consists of two pieces; a receptacle, to which the line connections are made and which is permanently fastened to the cross arm or other support, and a plug, which carries the fuse. To re-fuse it is necessary to remove the plug from the receptacle, thus making the block safe in operation.



With Fuse Wire  
In Position  
PLUG STYLE NO. 287306 FOR USE WITH RECEPTACLE  
STYLE NO. 241509

With Fuse Wire  
Blown

The contacts for the line wires are deeply recessed in the porcelain and well separated from each other, thus protecting them from the weather and accidental contact, and also from any possibility of arcing across the terminals. Connections to the contacts are made by inserting the wires through holes in the sides of the porcelain and securing them to the contact posts by means of set screws. The holes in the binding post and the set screws, are of ample proportions to render the connection of the block to the circuit a simple and easy matter.

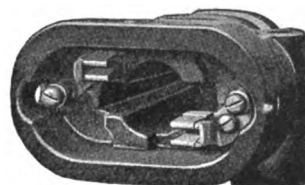
The interrupting capacity of these fuse blocks, when used one per wire, is approximately 800 amperes at 2500 volts.

In the 2500-volt size two blocks are listed; one non-indicating and one indicating and in the 5000-volt size, one block, non-indicating is listed.

#### Construction

Fuse block Style No. 147190, has a glazed exterior finish of a dark brown color and is of the non-indicating type.

The contacts are formed by spring clips; the



RECEPTACLE, STYLE NO. 241509

plug is pushed straight into the receptacle and held therein by the pressure exerted by the clips. In addition, each contact is fitted with a spring latch which engages an offset on the plug, thus obtaining a more secure contact and preventing the plug from falling to the ground when the fuse blows. The roll-contact feature on the plug makes this type of block interchangeable with a number of blocks of other manufacture. Contacts of both receptacle and plug are recessed into the porcelain, thus preventing loosening and twisting.

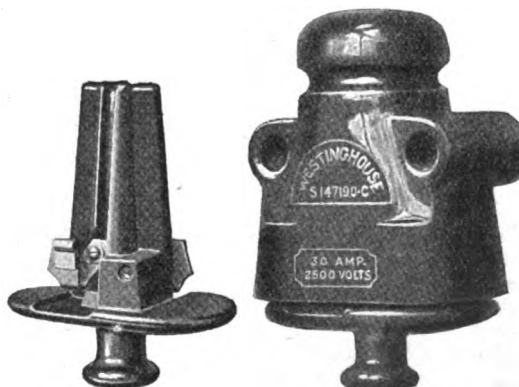
The fuse wire is placed in a groove that has rounded edges throughout its entire length, thus preventing any possibility of the fuse wire being cut.

Parallel to the groove is a rib which absorbs the shock incident to the insertion of the plug, and, thereby, greatly reduces possibility of breakage due to handling.

The plug terminates in a knob for handling. Immediately above the knob is a shield of ample area to provide protection for the hand of the operator.

Fuse block Style No. 287325 is of the indicating type. It uses the same receptacle as Style No. 147190 but a different plug.

This plug has the same general outlines as the one used with fuse block Style No. 147190 and is interchangeable with it. A hole extends through the body and knob of the plug, in each end of which a small piece of white glazed porcelain is mounted. The inner piece is depressed when a fuse is mounted



PLUG, STYLE NO. 241510

BLOCK COMPLETE,  
STYLE NO. 147190

1-310A

## DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

on the plug, thus putting the fuse under a slight tension. When the fuse blows this porcelain piece is interposed between the arcing ends of the fusible element, thus tending to interrupt the circuit.



RECEPTACLE, STYLE No. 375018

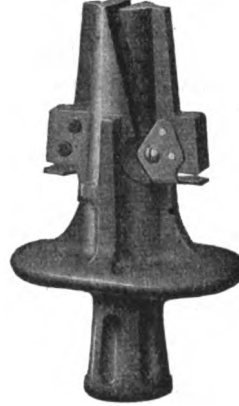
The porcelain piece in the other end projects beyond the knob handle when the fuse is in position, and recedes within the knob when the fuse parts. Thus the extension of the small white porcelain piece beyond the knob indicates that the fuse is intact and the recession within the knob indicates that the fuse has blown.

Fuse block **Style No. 375017**, of the non-indicating type, 5000 volts, has a glazed exterior finish of dark brown color.

The contacts are formed by spring clips. The plug is inserted in the receptacle and given a rotary motion to engage the contact in the receptacle. The plug is so designed that it is impossible to make contact until it is thrust completely into position and revolved the proper distance. The striking distances between terminals and contacts of this design have been increased over Style No. 147190 and a barrier is placed on the plug to increase the creepage distance.

A novel departure in this design is that of the method of mounting the blocks. Previously this type of block has been mounted on the cross arm by

wood screws placed through the porcelain. For the higher voltage work this decreases the striking distance, and, therefore, in the new design a U-shaped mounting bracket fitting under the shoulders of the



PLUG, STYLE No. 375019

block is used. Thus no screws are put through the porcelain and a simple and reliable mounting bracket is supplied.

The other features of this style are similar to those of Style No. 147190.

**Style number and list price** of the complete block include lag screws for mounting in the case of the 2500-volt block, and mounting bracket and mounting bolts in the case of the 5000-volt block, but do not include fuse wire which may be ordered separately. See other pages of this catalogue for fuse wire. The length of wire required for each fuse is nine inches. In the case of Style Nos. 147190 and 287325, standard link fuses listed below can be used if desired.

COMPLETE FUSE BLOCK  
STYLE No. 375017

DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

PRICES

Max. Amps	Max. Volts	Description	*Net Wt. Pounds	Style No.	List Price
30	2500	Non-Indicating Fuse Block complete	5 1/4	147190	\$3 25
30	2500	Receptacle only	4	241509	2 25
30	2500	Plug only	1 1/4	241510	1 00
30	2500	Indicating Fuse Block complete	5 1/4	287325	4 00
30	2500	Receptacle only	4	241509	2 25
30	2500	Plug only	1 1/4	287306	1 75
30	5000	Indicating fuse block complete	7	375017	4 60
30	5000	Receptacle only	5 1/4	375018	3 15
30	5000	Plug only	1 1/2	375019	1 40
30	5000	Mounting bracket including bolts	1/4	375020	25

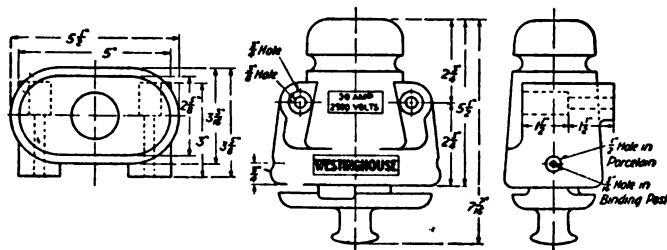
\*Shipping weight in quantities is approximately 10 per cent greater.

LINK FUSES

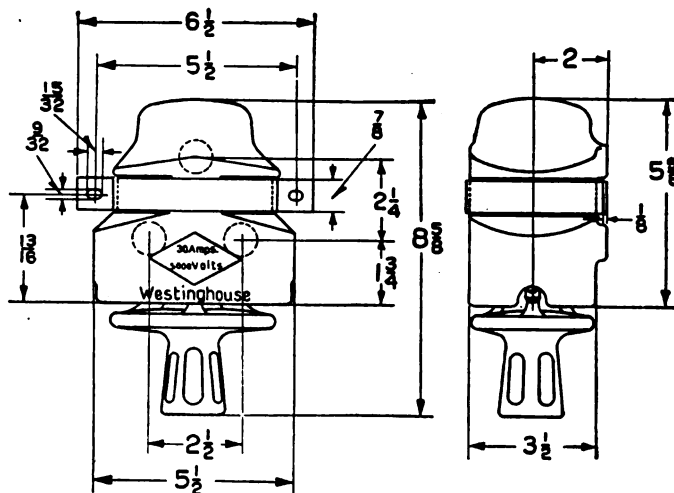
Fuses for use in plug-type transformer fuse blocks, Style No. 147190.

Continuous Capacity Amperes	Standard Package Quantity	Style No.	List Price
1	100	224172	\$6 00
2	100	224173	6 00
3	100	224174	6 00
5	100	224175	6 00
10	100	224176	6 00
15	100	224177	6 00
20	100	224178	6 00
25	100	224179	6 00
30	100	224180	6 00

OUTLINE DIMENSIONS



STYLE No. 147190



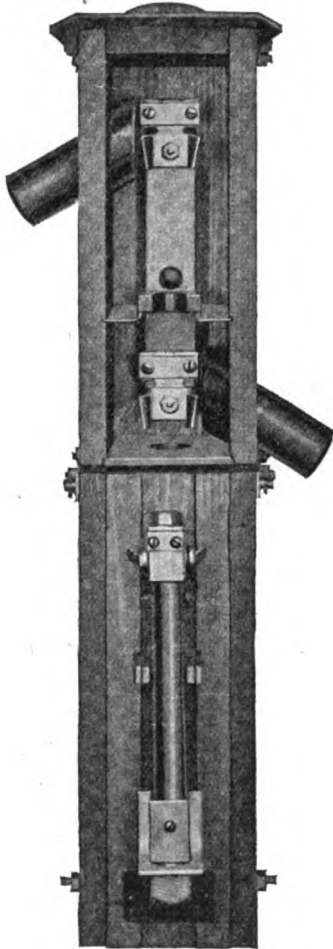
STYLE No. 375017

Order by Style Number

## DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

## TYPE OD SAFETY-FIRST FUSE BOXES

For Use on Circuits up to 7500 Volts



100-AMPERE BOX, OPEN

**Application**

The Westinghouse type OD safety-first fuse box is ideal for the protection of outdoor distributing transformers. All parts that require handling, when it is necessary to re-fuse the box, are removed from contact with the live parts by opening the door. Safety from accidental contact is assured the operator.

**Distinctive Features**

1. Heavy, compact, substantial box with through-bolts prevents warping.
2. A one-piece metal top keeps the moisture out of the box, forms the mounting bracket and part of the very simple latching device.

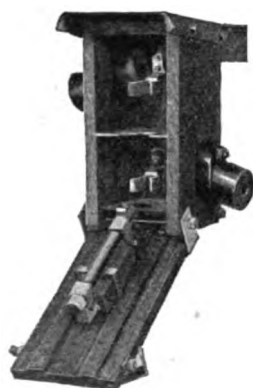
3. The mounting bracket at the extreme top of the box places the box on the cross arm as far below the transmission wires as possible. This feature adds to safety during installation and re-fusing.
4. The bottom opening door, swinging through 180 degrees, allows re-fusing at the maximum distance from the live parts. As an additional safety, the door of the 30-ampere box must be swung approximately 180 degrees before it can be taken off.
5. The Fuse tube is made of hard, dense, bone fibre of ample size, which assures long life and adequate protection on severe short circuits.
6. Blowing takes place at the decreased portion at the upper end of the fuse link, and a quick opening of the circuit is thus obtained.
7. There is an interior barrier in the box which confines the gases to the lower chamber, and prevents any possibility of arcing between the upper and lower contacts.
8. The base and outlet bushing are formed in one piece of moulded insulating material to insure proper insulation and to prevent charring.
9. The fuse tube projects down into the outlet bushing in order that the hot gases may expand into the outer atmosphere instead of into the box.
10. All screws used in the 30-ampere box to clamp the line wires and the fuse links are non-removable and cannot be lost.
11. The simple, yet effective, way of clamping the fuse link without screws in the upper fuse tube of the 30-ampere box, and the non-removable screw with its free self-lifting washer, make re-fusing very easy and allow it to be done quickly.
12. Two screws clamp each end of the fuse link of the 100-ampere fuse box.
13. Both fuse boxes have a very high interrupting capacity.

**Operation**

The fuse tube is open at the bottom and is provided with a terminal which closes the top end. When the fuse blows, the gases are expelled from the bottom of the tube through the opening in the base of the box. The opening is formed as part of the moulded base and the fuse tube projects down into the opening. This arrangement greatly aids in the proper expulsion of the gases from the box and gives greater interrupting capacity.

## DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

**To Re-Fuse**—No hook stick, tongs or other tools, except a screw driver for clamping the fuse link in the tube, are necessary to re-fuse this box. When the door of the box is opened, the fuse tube is disconnected and insulated from the line.



30-AMPERE BOX WITH DOOR PARTIALLY OPENED

In the 30-ampere box, the fuse tube is permanently fastened to the mounting block on the door, and the door can be safely and easily removed from the box. In the case of the 100-ampere box, the fuse tube is safely and easily disengaged from the insulating block on the door. The fuse tube is re-fused, and can be inserted in place by one hand. The door is closed and the box is again in operation.

Standard listed refills should be used in all cases for both the 30 and 100-ampere boxes because the box is designed for these special refills, and only by their use can the successful and maximum operation of the box be guaranteed.

**Interrupting Capacity**—The interrupting capacity of the 30-ampere box is approximately 1000 amperes at 7500 volts, and of the 100-ampere box is 2000 amperes at 7500 volts when used one per wire and proportionally greater at lower voltages.

### Construction

**30-Ampere Box**—This box is made of well seasoned swamp cypress treated with creosote and it is permanently held together with galvanized through-bolts. This construction precludes any possibility of the box warping and allowing moisture to get inside. The one-piece galvanized sheet-iron top also keeps moisture out of the box and forms a very desirable mounting bracket for mounting the box on the cross arm.

A recess in the metal top forms part of the latching device. The end of the handle enters this recess and cannot be disengaged without a sidewise rotation of the handle, so that it is impossible for the box to open accidentally.

The fuse tube is made from dense hard bone fibre. This material has been found very satisfactory for making the tubes of the renewable fuses and will withstand severe service. It is threaded into the upper contact block and is clamped against the porcelain base by the lower contact block. The contact blocks enter into the flared copper knife contacts mounted in the box. The fuse tube with its contact blocks is mounted on a one-piece porcelain securely fastened to the door.

In case the fuse tube is damaged it can be removed from the porcelain by simply removing two cotter

pins. Thus the fuse tube, porcelain and door are combined in one unit, that is not too large or too small to handle while re-fusing.

The door swings vertically about an axis at the front, bottom of the box. It can only be taken out to re-fuse at a position approximately 180° from the closed position, this being a maximum distance from the live parts. This feature gives additional safety.

At the top of the fuse tube there is a hexagon shaped cap that can be removed easily for re-fusing and closes the top end of the tube. The fuse link at this end consists of a round wire which is wound around a stud in the top tube terminal and then clamps by screwing the hexagon cap in place. The lower end of the fuse link, which is of greater current carrying capacity, is inserted under a washer on the lower tube terminal and held clamped by a screw. This screw is non-removable and the washer lifts with the head of the screw but is free to turn. Everything was done in the design of this fuse tube to facilitate re-fusing and at the same time insure good contact.

Each knife contact and line terminal is mounted on a one-piece porcelain, which is securely fastened to the side of the box. These porcelains also serve as entrance bushings for the incoming and outgoing wires, making a very compact and desirable combination base and bushing. Connection is made to the box by clamping the line wires, each under a plate held by two screws. These screws are arranged so they cannot be entirely unscrewed and lost from the box. This makes the installation of the box simple and at the same time provides good contact.

The fuse element has a decreased cross-section at the upper end so that the arc will occur at the top of the tube. The action then is to expel the fuse element downward through the open end of the tube and thus to assist in breaking the arc.

In previous designs of outdoor safety-first fuse boxes there has been a tendency to arc between upper and lower contacts; also the gases tend to expand into the interior of the box instead of into the outer atmosphere, because there is a small space between the lower end of the tube and the bottom of the box. The result has been a decreased interrupting capacity of the box. To overcome this disadvantage and to increase the rupturing capacity, a barrier of insulating material has been placed inside the box. Also when the box is closed the fuse tube projects down into the outlet. The outlet bushing and base are made of one piece of insulating material to insure proper insulation and to prevent charring.



30-AMPERE BOX WITH DOOR REMOVED FOR RENEWING THE FUSE LINK

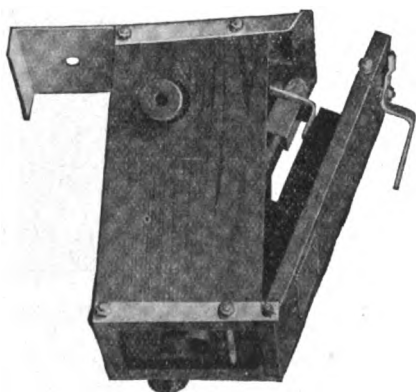
## DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

**100-Ampere Box**—The construction of the sides, back, door, bottom, steel roof and bracket, handle and latching means, the arc barrier of the 100-ampere box, and the fuse links, are similar to those of the 30-ampere box except that the parts are larger to accommodate the larger fuse tube and current carrying parts.

The through-bolt at the bottom of the door forms an axis about which the door revolves vertically. The fuse tube is made of the same dense, hard, bone fibre as the 30-ampere fuse tube. It is threaded into the upper end and clamped into the lower contact blocks which enter into the flared copper knife contacts mounted in the box. The fuse tube is mounted on a one-piece porcelain which is held securely to the door and the door held in place by a simple latching means. By merely lifting a lever of the fuse tube latch, which is held in place by a spring, the fuse tube can be taken off the door to re-fuse.

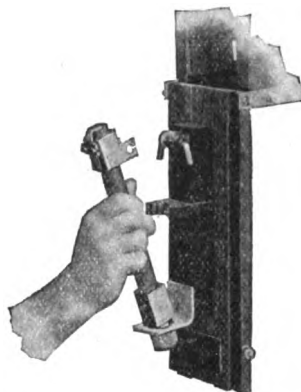
The knife fingers and the terminals are mounted on a piece of porcelain similar to that which holds the tube, fastened to the inside of the back piece of the box. The incoming and outgoing wires, entering through substantial porcelain bushings, are fastened to the stationary contacts by clamping them under plates that are held by two screws, thus making the installation of the box extremely simple, and giving at the same time, good contacts.

At the top of the fuse tube there is a cylindrical cap that can be removed easily for re-fusing, and which forms the upper end of the expulsion chamber. The fuse link is fastened at both ends of the tube by inserting it under plates held by two screws to assure good contact and to facilitate re-fusing.



100-AMPERE BOX WITH DOOR PARTLY OPEN SHOWING AT THE BOTTOM OF THE BOX THE ONE-PIECE MOLDED COMPOSITION BASE AND VENT FOR GASES

In previous designs of fuse boxes little attention was paid to operation on gradual overloads, the fuse boxes usually being designed for short-circuit protection only. In this latest design an overload auxiliary can be supplied. It consists of a micarta tube with a metal stop at the lower end. With the



REPLACING THE FUSE TUBE ON THE 100-AMPERE BASE

ordinary fuse link on gradually increasing overloads the quantity of gas generated is small and the pressure is low, so that even if the element blows it may not be separated enough to extinguish the arc. When the overload auxiliary is used the hot gases generated by the overloads are sufficient to force the auxiliary refill out of the tube. This is done by burning the fuse link in two at the bent section at the upper end of the fuse tube and causing a pressure to be exerted on the metal stop of the auxiliary refill. By forcing the refill out in this manner two arcs are introduced, one at the upper end and one at the lower end of the fuse tube, and as these two are lengthened sufficiently, the circuit is broken. On short circuits the auxiliary refill is blown out of the fuse tube and the circuit is opened equally as well as with standard refills listed for use with this box.

Style number and list prices for the 30 and 100-ampere boxes include the box complete without the refill or auxiliary overload, but with hanger iron for mounting on a 4-inch cross arm. The hanger irons for cross arms of other sizes can be supplied only at a considerable increase in price. Style number and list price of the overload auxiliary for the 100-ampere box include the complete overload auxiliary without the fusible element.

Style number and list price of the refill include the complete fuse link for use with the 30 or 100-ampere fuse boxes.

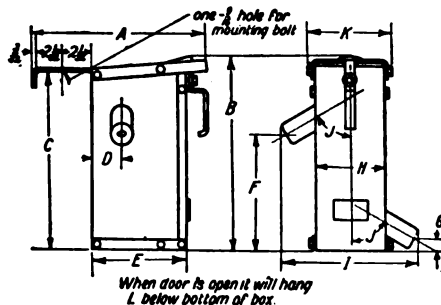


DISTRIBUTION TRANSFORMER FUSE BLOCKS AND BOXES—Continued

PRICES

Ampere Capacity	Description	Standard Package	APPROX. WEIGHT PER PACKAGE		Style No.	List Price Each
			Net	Gross		
30	Box complete	2	25 lb.	31 lb.	374880	\$11 10
100	Box complete	2	32 lb.	38 lb.	323795	18 30
30	Fuse tube	2	3 lb.	5 lb.	374881	2 60
100	Fuse tube	2	6 lb.	8 lb.	323796	4 18
5 to 100	Overload auxiliary	5	20 oz.	22 oz.	323812	40
1	Refill for Style No. 374880	10	2 oz.	4 oz.	374882	30
2	Refill for Style No. 374880	10	2 oz.	4 oz.	374883	30
3	Refill for Style No. 374880	10	2 oz.	4 oz.	374884	30
5	Refill for Style No. 374880	10	2 oz.	4 oz.	374885	30
7	Refill for Style No. 374880	10	2 oz.	4 oz.	374886	30
10	Refill for Style No. 374880	10	2 oz.	4 oz.	374887	30
12	Refill for Style No. 374880	10	3 oz.	5 oz.	374888	30
15	Refill for Style No. 374880	10	3 oz.	5 oz.	374889	30
20	Refill for Style No. 374880	10	3 oz.	5 oz.	374890	30
25	Refill for Style No. 374880	10	3 oz.	5 oz.	374891	30
30	Refill for Style No. 374880	10	3 oz.	5 oz.	374892	30
5	Refill for Style No. 323795	10	2 oz.	4 oz.	323797	40
8	Refill for Style No. 323795	10	2 oz.	4 oz.	323798	40
10	Refill for Style No. 323795	10	2 oz.	4 oz.	323799	40
15	Refill for Style No. 323795	10	2 oz.	4 oz.	323800	40
20	Refill for Style No. 323795	10	3 oz.	5 oz.	323801	40
25	Refill for Style No. 323795	10	3 oz.	5 oz.	323802	40
30	Refill for Style No. 323795	10	3 oz.	5 oz.	323803	40
40	Refill for Style No. 323795	10	4 oz.	6 oz.	323804	40
50	Refill for Style No. 323795	10	4 oz.	6 oz.	323805	40
60	Refill for Style No. 323795	10	4 oz.	6 oz.	323806	40
70	Refill for Style No. 323795	10	4 oz.	6 oz.	323807	40
75	Refill for Style No. 323795	10	4 oz.	6 oz.	323808	40
80	Refill for Style No. 323795	10	4 oz.	6 oz.	323809	40
90	Refill for Style No. 323795	10	5 oz.	7 oz.	323810	40
100	Refill for Style No. 323795	10	5 oz.	7 oz.	323811	40

APPROXIMATE DIMENSIONS IN INCHES



Style No.	Ampere Capacity	DIMENSIONS IN INCHES											
		A	B	C	D	E	F	G	H	I	J	K	L
374880	30	11 1/8	10 3/8	9 3/8	2 1/8	5 3/8	6 1/8	1 1/8	5	9	70°	5 3/8	9
323795	100	12 1/8	13 3/8	12 3/8	2 3/8	6 3/8	8 1/8	1 3/8	5 3/8	9 3/8	60°	6	12 3/8

Order by Style Number

## ENCLOSED CARTRIDGE FUSES

2500 to 25,000 Volts

Non-Renewable for Indoor Service

With Indicators\*



2500-VOLT ENCLOSED  
CARTRIDGE FUSE  
BASE



ENCLOSED CARTRIDGE FUSE  
BASE FOR VOLTAGES  
ABOVE 2500 UP TO 25,000

### Application

Enclosed fuses, used so universally on low voltage, have been applied for several years to higher voltages. On these higher voltages they are very successful and afford excellent protection for power circuits of low capacity. A new line of fuses has been developed with a maximum interrupting capacity on short circuits for this type of fuse. 2500-volt fuses will also open circuits on slow overloads. Fuses of this type for 4500 volts and above will not open slow overloads on their rated voltage due to the nernst effect in the filler, but may be

derated in accordance with the table given in this section and used to give full overload protection. At full rated voltage, the fuses will open circuits between five times rating and the interrupting capacity given in the table.

This failure to open slow overloads is not objectionable in a large number of applications, due to the practice of fusing transformers at 200 per cent of full-load rating. Thus currents that exceed the blowing point of the fuse and continue longer than the time element of the fuse are due to trouble which will allow a short-circuit current to flow.

### Construction

The casing for these fuses is made from strong fibre tubing treated to prevent warping due to absorption of moisture. The caps are copper-plated drawn steel to give strength. These caps are attached to the casing by screws. Two of these screws pass through the casing into a special nut on the inside thus effectively clamping the casing and ruggedly attaching the cap to the casing.

The venting of the gases in these fuses has received special attention. Vent holes are provided in the caps and are covered on the inside with washers of woven asbestos cloth. The number of these washers in each size fuse is adjusted to give the proper venting. The gas is sufficiently confined to get increased pressure to effectively extinguish the arc and still is not confined to such an extent as to explode the tube within the capacity of the fuse.

### PRICES

Style number and list price of the fuse include the fuse with indicator as specified above and style number and list price of fuse block include block complete without fuses.

Fuses					
Ampere Capacity	Standard Package	Carton Quantity	Approx. Net Wt. per carton†	Style No.	List Price Each
<b>For Voltages up to 2500</b>					
1	10	2	1/4	318417	\$1 75
2	10	2	1/4	318418	1 75
3	10	2	1/4	318419	1 75
4	10	2	1/4	318420	1 75
5	10	2	1/4	318421	1 75
6	10	2	1/4	318422	1 75
8	10	2	1/4	318423	1 75
10	10	2	1/4	318424	1 75

Ampere Capacity	Standard Package	Carton Quantity	Approx. Net Wt. Per Carton†	Style No.	List Price Each
<b>For Voltages up to 2500</b>					
12	10	2	1/4	318425	\$1 75
15	10	2	1/4	318426	1 75
16	10	2	1/4	318427	1 75
18	10	2	1/4	318428	1 75
20	10	2	1/4	318429	2 60
25	10	2	1/4	318430	2 60
30	10	2	1/4	318431	2 60
35	10	2	1/4	318432	3 00
40	10	2	1/4	318433	3 00
45	10	2	1/4	318434	3 00
50	10	2	1/4	318435	3 00
55	10	2	1/4	318436	3 00
60	10	2	1/4	318437	3 00
70	10	2	1/4	318438	3 40
80	10	2	1/4	318439	3 40
90	10	2	1/4	318440	3 40
100	10	2	1/4	318441	3 40

\*Fuse of from 1 to 4 amperes capacity do not have indicators.  
 †The 5-ampere, 25,000-volt fuse does not have an indicator.  
 ‡For shipping weight, add 10% to net weight.

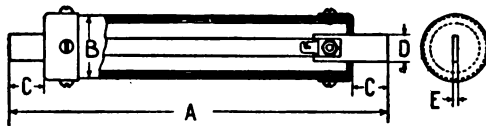
Order by Style Number

ENCLOSED CARTRIDGE FUSES—Continued

Ampere Capacity	Standard Package	Carton Quantity	Approx. Net Wt. Per Carton†	Style No.	List Price Each	Ampere Capacity	Standard Package	Carton Quantity	Approx. Net Wt. Per Carton†	Style No.	List Price	
<b>For Voltage up to 4500</b>						<b>For Voltages up to 15,000</b>						
1	10	2	1/2	318442	\$3 50	1	10	2	1	318469	\$4 50	
2	10	2	1/2	318443	3 50	2	10	2	1	318470	4 50	
3	10	2	1/2	318444	3 50	3	10	2	1	318471	4 50	
4	10	2	1/2	318445	3 50	4	10	2	1	318472	4 50	
5	10	2	1/2	318446	3 50	5	10	2	1	318473	4 50	
6	10	2	1/2	318447	3 50	6	10	2	1	318474	4 50	
7	10	2	1/2	318448	3 50	7	10	2	1	318475	4 50	
8	10	2	1/2	318449	3 50	8	10	2	1	318476	4 50	
9	10	2	1/2	318450	3 50	9	10	2	1	318477	4 50	
10	10	2	1/2	318451	3 50	10	10	2	1	318478	4 50	
12	10	2	1/2	318452	3 50	<b>For Voltages up to 25,000</b>						
14	10	2	1/2	318453	3 50	1	10	2	1 1/2	318479	5 00	
16	10	2	1/2	318454	3 50	2	10	2	1 1/2	318480	5 00	
18	10	2	1/2	318455	3 50	3	10	2	1 1/2	318481	5 00	
20	10	2	1/2	318456	3 50	4	10	2	1 1/2	318482	5 00	
						5	10	2	1 1/2	318483	5 00	
<b>For Voltages up to 7500</b>						<b>Bases</b>						
1	10	2	1	318457	\$4 00	Volts	Net Weight	Style No.	List Price			
2	10	2	1	318458	4 00	2500	4	364330	\$3 15			
3	10	2	1	318459	4 00	4500	15	364331	9 25			
4	10	2	1	318460	4 00	7500	35	364332	11 50			
5	10	2	1	318461	4 00	15000	40	364333	14 50			
6	10	2	1	318462	4 00	25000	60	364334	18 00			
7	10	2	1	318463	4 00	<b>Fuse Tong</b>						
8	10	2	1	318464	4 00			Style No.	List Price			
9	10	2	1	318465	4 00			For use with all fuses.....	365032	\$12 00		
10	10	2	1	318466	4 00							
12	10	2	1	318467	4 00							
15	10	2	1	318468	4 00							

†For shipping weight add 10 per cent to net weight.

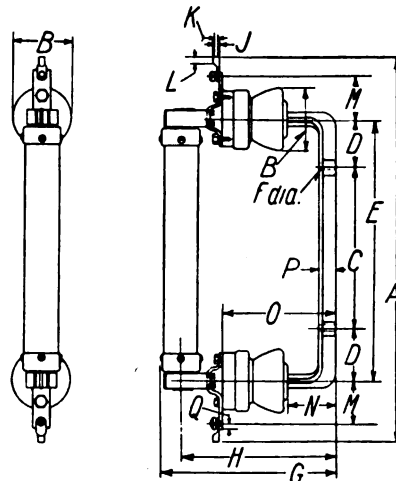
OUTLINE DIMENSIONS IN INCHES



ENCLOSED CARTRIDGE FUSE

Enclosed Cartridge Fuses

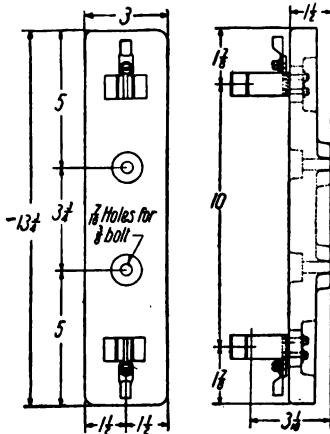
Volts	Amps.	A	B	C	D	E
2500	0-30	11	1 1/2	1 1/2	3/4	1/2
2500	31-60	11	1 1/2	1 1/2	3/4	1/2
2500	61-100	11	2	1 1/2	3/4	1/2
4500	0-20	14	2	1 1/2	3/4	1/2
7500	0-15	17	2	1 1/2	3/4	1/2
15000	0-10	20	2	1 1/2	3/4	1/2
25000	0-5	23	2	1 1/2	3/4	1/2



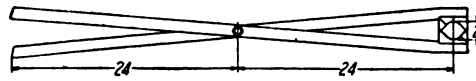
FUSE BASE FOR VOLTAGES FROM 4500 TO 25,000

Enclosed Cartridge Fuse Base

Volts	Amps.	A	B	C	D	E	F	G	H
4500	0-20	20	3 1/4	8	2 1/2	13	1 1/2	10	8 1/2
7500	0-15	23	3 3/4	8	4	16	1 1/2	10	8 1/2
15000	0-10	26	6	12	3 1/2	19	1 1/2	11 1/2	9 1/2
25000	0-5	29	7	12	5	22	1 1/2	12 1/2	11
Volts	Amps.	J	K	L	M	N	O	P	Q
4500	0-20	.344	.259	1/8	2 1/8	2 3/4	6 1/8	1	3/8
7500	0-15	.344	.259	1/8	2 1/8	2 3/4	6 1/8	1	3/8
15000	0-10	.344	.259	1/8	2 1/8	3 1/8	7 1/2	1	3/8
25000	0-5	.344	.259	1/8	2 1/8	3 1/8	8 3/8	1	3/8



2500-VOLT FUSE BASE



FUSE TONGS

Order by Style Number

## EXPULSION-TYPE FUSE BLOCKS

### FRONT-CONNECTED

For Capacities up to 100 Amperes—For Voltages 2500 to 25,000

#### Application

These fuse blocks are made especially for opening the circuit in the event of sudden and severe overloads or short-circuits, but they are also entirely suitable for the protection of circuits in the case of gradually increasing overloads if the fuse wire is inserted in asbestos sleeving. They are for indoor mounting only.

They will operate satisfactorily on any circuit within their interrupting capacity, which is approximately 1000 amperes at 7500 volts when used one per wire and proportionately greater or less at other lower or higher voltages.

**Caution**—In order that these fuse blocks can be "cut dead" before the operator handles them, it is recommended that disconnecting switches be used in series with them when operated on a power circuit. Fuse tongs should be used only where the power capacity back of the fuses is known to be limited by such apparatus as voltage transformers.

**Distinctive Features**—The distinctive features of these expulsion-type fuse blocks are: cast iron yoke; petticoat-type insulators; double tube, insuring rigidity of contacts; knife-blade jaws; light weight with substantial construction; readiness of installation and of re-fusing.

#### Construction

The fuse tube consists of two micarta tubes, one within the other. The ends of the outer tube are fitted with brass clips, that make contact with the copper jaws which support the tube. On the 2500-volt block these jaws are mounted on studs. This block should be mounted on a marble panel. On the blocks for other voltages the jaws are mounted on porcelain insulators supported on a cast-iron

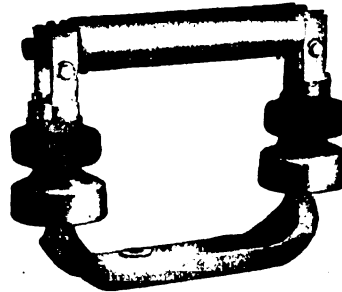


FIG. 1—7500 VOLTS

yoke or base. Two holes are provided in the base for mounting screws.

The fuse wire, enclosed in asbestos sleeving, is secured by a screw and washer at one end to a terminal in the expulsion chamber and at the other end to a terminal on the contact block.

#### Operation

The fuse tube is hollow and one end is left open, so that when the fuse blows, the metallic vapors are expelled from the tube through the open end and successfully extinguish any arc incident to the blowing of the fuse. Before being inserted in the fuse tube the fuse wire should be enclosed in asbestos sleeving. The asbestos sleeving prevents the gradual charring of the inside of the fuse tube by the overheated fuse and thereby eventually lengthens the life of or prevents burning out of the fuse tube. The open end of the fuse tube extends beyond the contact jaw so that all danger of the expelled vapors coming in contact with the metallic portion of the block is eliminated.

### RATINGS AND PRICES

Style number and list price include the fuse block complete including the fuse tube, ready for mounting. Fuse wire and asbestos sleeving (see pages of this catalogue on "Fuse Wire" and "Insulating Materials and Supplies") are not included and must be ordered separately. Aluminum or Nickel Silver fuse wire should be used.

Amperes	Maximum Voltage	Mounting	Length of Fuse Wire Required Per Block, Inches	APPROX. WT., LBS.		Style No.	List Price
				Net	Boxed		
<b>Fuse Blocks</b>							
Up to 100	2500	Switchboard	11	8	9	124414	\$28 00
Up to 100	7500	Wall	14	13	14½	124401	37 00
Up to 100	15000	Wall	19	24	26½	124402	44 00
Up to 100	25000	Wall	28	28	31	124413	51 00
<b>Fuse Tubes</b>							
.....	2500	.....	.....	4	4½	185312	14 00
.....	7500	.....	.....	6	6½	185313	17 00
.....	15000	.....	.....	9	10	185314	19 00
.....	25000	.....	.....	12	13½	185315	21 00

#### Fuse Tongs

See pages of this catalogue on "Enclosed Cartridge Fuses."

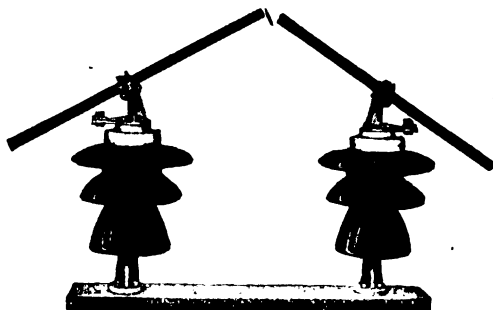
Order by Style Number

1-507A

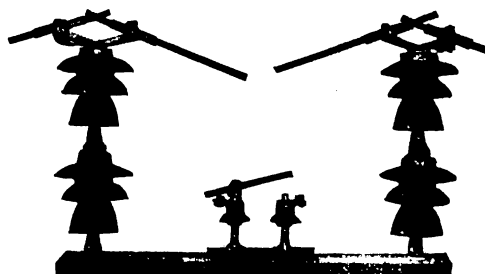
## TYPE R EXPULSION FUSES

Outdoor—4500 to 110,000 Volts Upright, Inverted and 45° Mounting

For Power and Potential Circuits



TYPE R EXPULSION FUSE, UPRIGHT-MOUNTING,  
OUTDOOR—73,000 VOLTS



TYPE R EXPULSION FUSE, UPRIGHT-MOUNTING, OUTDOOR—  
COMPARATIVE SIZES OF 4500 AND 110,000-VOLT FUSES

### Application

The type R expulsion fuses have the highest interrupting capacity of any high voltage fuse now on the market. They are made for voltages of from 4500 to 110,000 volts and for currents up to 200 amperes. They are made for upright, inverted and 45° mounting.

For power circuits they are particularly adapted to opening short circuits. Their ability to open short-circuit currents when used with fuse links as listed is shown in the table below. On slow overloads, there is a tendency for the arc to hold on for a sufficient length of time to char the micarta tube. This condition, however, is not objectionable since it is unusual practice to fuse a transformer at 200 per cent of normal rating and currents which are large enough and endure long enough to blow the fuse invariably develop into short circuits which the fuse opens easily. The very infrequent overloads may damage the tube, but is relatively inexpensive to renew the tubes.

For potential circuits such as the protection of voltage transformers, the one-ampere fuse may be used in applications where its interrupting capacity is not exceeded.

### Distinctive Features

- High interrupting capacity.
- Easily and cheaply re-fused.
- Insulators interchangeable with type R disconnecting Switches and type R re-designed choke coils.
- Clamp terminal for line wires.
- Clamp connection for fuse element.
- Heavy channel iron bases.

### Construction

**Base**—The bases for the type R fuses are of heavy channel iron, hot-dipped galvanized and are of the same type as used on the type R disconnecting switches.

**Insulators**—The standardized insulator assemblies with galvanized hardware, which are the same type as is used on type R disconnecting switches are used with these fuses. Complete description of this type of insulator will be found in the portion of this catalogue covering type R disconnecting switches.

**Fuse Tubes**—The fuse tubes are of micarta treated with a special block varnish to make the tube proof against weather and acid.

**Fuse Links**—Fuse links as given in the table in this section are recommended. They are especially calibrated for this type of fuse. The metals used on the fuses for 15 to 200 amperes are selected because of their low melting point and their inherent characteristics which assure good fuse operation. The low melting point prevents charring of the tube on slow overloads up to the time the fuse melts. The alloy used on the 1 to 5-ampere fuses is selected for its high resistance so that the material will have sufficient mechanical strength.

### Interrupting Capacity

Voltage	INTERRUPTING CAP. IN AMP. AT RATED VOLTAGE			
	1 Amp.	2 to 60	61 to 125	126 to 200
4500	10000	7000	6000	5000
7500	5000	4000	3500	3000
15000	3000	2000	1750	1500
25000	3000	2000	1750	1500
37000	2000	1500	1300	....
50000	1500	1000	900	....
73000	900	600	....	....
88000	700	500	....	....
110000	600	400	....	....

TYPE R EXPULSION FUSES—Continued

PRICES

Style number and list price include the fuse block complete with fuse tube but without fuse wire which should be ordered separately from separate tables.

Voltage Rating	Maximum Amperes Recommended for Fuse Link	Length of Fuse Link Inches	APPROX. Wt., Lbs.		Style No.	List Price
			Net	Shipping		
<b>Upright Mounting</b>						
Maximum						
4500	200	32	45	65	370856	\$21 00
7500	200	32	60	90	370857	24 00
15000	150	37	85	130	370858	33 00
25000	150	55	105	160	370859	42 00
37000	100	80	135	205	370860	54 00
50000	75	95	160	240	370861	64 00
73000	40	105	188	280	370862	80 00
Normal						
88000	30	145	250	325	370863	110 00
110000	20	160	375	565	370864	200 00
<b>Inverted Mounting</b>						
Maximum						
4500	200	32	45	65	370865	21 00
7500	200	32	60	90	370866	24 00
15000	150	37	85	130	370867	33 00
25000	150	55	105	160	370868	42 00
37000	100	80	135	205	370869	54 00
50000	75	95	160	240	370870	64 00
73000	40	105	185	280	370871	80 00
Normal						
88000	30	145	250	325	370872	110 00
110000	20	160	375	565	370873	200 00
<b>45° Mounting</b>						
Maximum						
4500	200	32	45	65	370874	32 00
7500	200	32	60	90	370875	35 00
15000	150	37	85	130	370876	44 00
25000	150	55	105	160	370877	53 00
37000	100	80	135	205	370878	65 00
50000	75	95	160	240	370879	75 00
73000	40	105	185	280	370880	91 00
Normal						
88000	30	145	250	325	370881	125 00
110000	20	160	375	565	370882	215 00

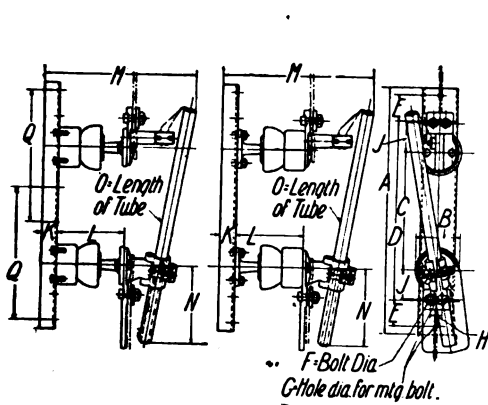
FUSES RECOMMENDED FOR USE IN TYPE R HIGH-VOLTAGE EXPULSION FUSES

Safe Carrying Capacity Amperes	Approx. Blowing Amperes	Size of Wire or Ribbon in Inches	Approx. No. of Ft. per Lb.	Net Weight of Standard Package (Spools) Lb.	List Price Per Lb.
<b>Nickel Silver Wire (18 Per Cent)</b>					
1	1.6	.004 Diam.	20700	1/4	\$2 00
2	2.8	.0063 Diam.	8300	1/4	2 00
3	4.0	.0069 Diam.	4170	1/4	2 00
<b>Tin Wire</b>					
5	6.25	.0285 Diam.	510	1/2	3 00
7	8.75	.040 Diam.	260	1/2	3 00
10	12.50	.051 Diam.	125	1	3 00
15	18.75	.072 Diam.	80	1	3 00
<b>Zinc Ribbon</b>					
20	2.5	.0085* 215	176	1	1 15
25	31.3	.0085* 28	135	1	1 15
30	37.5	.0085* 355	107	1	1 15
40	50.	.0085* 500	76	1	1 15
50	62.5	.013 * 500	50	1	95
60	75.	.018 * 500	36	1 1/2	75
70	87.5	.0235* 500	27	1 1/2	75
80	100.	.0295* 500	22	2	75
90	113.	.036 * 500	18	2	75
100	125.	.043 * 500	13	2	65
110	138.	.0416* 625	12	3	65
125	156.	.0514* 625	10	3	60
150	188.	.0664* 625	8	3	60
175	219.	.0836* 625	6	3	55
200	250.	.104 * 625	5	3	55

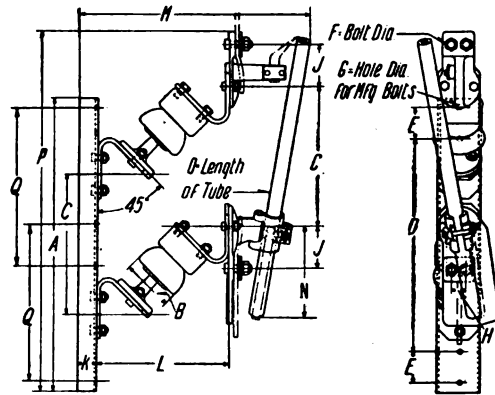
\*These sizes are made up of two parallel strips. This arrangement increases flexibility.

TYPE R EXPULSION FUSES—Continued

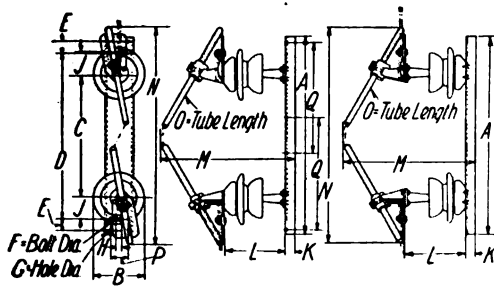
DIMENSIONS IN INCHES



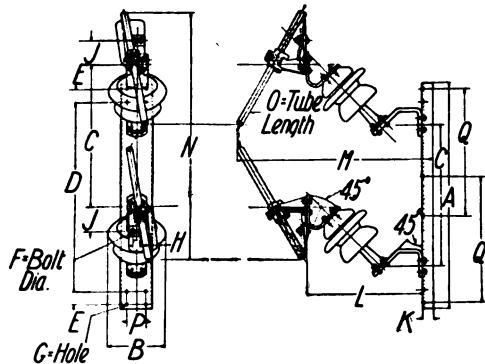
4500 TO 15,000 VOLTS



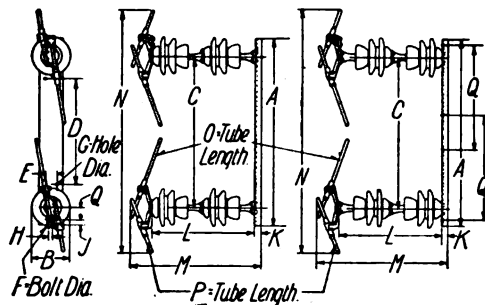
4500 TO 15,000 VOLTS



25,000 TO 73,000 VOLTS



25,000 TO 73,000 VOLTS



88,000 AND 110,000 VOLTS

Voltage	Mounting	DIMENSIONS IN INCHES															
		A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q
4500	Upright	24	3¾	10	17½	2½	¾	¾	1½	3	1¾	5¾	12¾	6½	20		12
4500	45°	24	3¾	10	17½	2½	¾	¾	1½	3	1¾	9½	16½	6½	20	27¼	12
7500	Upright	24	6	14	21½	2½	¾	¾	1½	3	1¾	7½	14½	6½	20		12
7500	45°	24	6	14	21½	2½	¾	¾	1½	3	1¾	10½	18½	6½	20	27¼	12
15000	Upright	30	7	16	23½	2½	¾	¾	1½	3	1¾	8½	16½	6½	25		12
15000	45°	30	7	16	23½	2½	¾	¾	1½	3	1¾	12½	21	6½	25	35¼	12
25000	Upright	40	9	22	33½	2½	¾	¾	1½	3¾	1¾	10½	23½	39	20	3	12
25000	45°	40	9	22	33½	2½	¾	¾	1½	3¾	1¾	17½	30½	39	20	3	12
37000	Upright	40	10½	26	33½	2½	¾	¾	1½	3¾	1¾	12½	26	47½	25	3	12
37000	45°	40	10½	26	33½	2½	¾	¾	1½	3¾	1¾	18½	32½	47½	25	3	12
50000	Upright	44	13¼	32	47½	2½	¾	¾	1½	4	1¾	17½	32½	58½	30	3	20
50000	45°	54	13¼	40	47½	2½	¾	¾	1½	4	1¾	24½	39¼	66½	30	3	20
73000	Upright	54	15	40	57½	2½	¾	¾	1½	4	1¾	20½	38	67	35	3	20
73000	45°	64	15	52	57½	2½	¾	¾	1½	4	1¾	29¼	46¼	79	35	3	20
88000	Upright	64	15¼	52	40	4	¾	¾	1½	2½	2¼	35	45	84	30	20	4
110000	Upright	76	15	64	50	5	¾	¾	1½	1½	2½	41	51	96	35	20	4

These dimensions are for reference only. For official dimensions apply to nearest district office.

# MOTOR-STARTING KNIFE SWITCHES

For Starting Capacities up to 3600 Amperes  
Rear-Connected—For Voltages up to 600

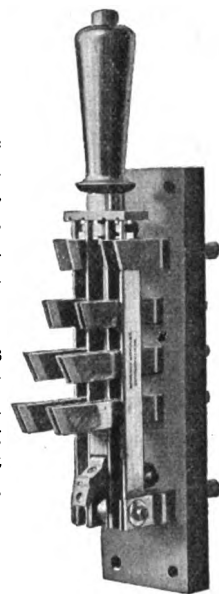
**Application**—These switches are used as a simple and inexpensive method of starting rotary converters from the direct-current end and direct-current motors of large capacity having starting conditions that will permit cutting out the starting resistance in four steps. They are intended for starting conditions only, being rated in terms of the starting current, and a short-circuiting line switch or circuit-breaker should be used to carry the running load. They will, however, carry one-fourth their rated current continuously, so that the short-circuiting line switch can be omitted where the full-load current is only one-fourth of the starting-current rating.

**Operation**—To start a motor the switch blade is thrown into the first jaw and after a moment's pause between steps, into each succeeding jaw until the last is closed. The short-circuiting line switch, where used, is then thrown in. The circuit should

always be opened by opening the line switch or circuit-breaker.

**Construction**—These switches have four sets of contacts of such length that the switch blade makes contact with each set in succession. Each switch has four blades, a construction that allows of ample ventilation and reduces the depth of the switch from the switchboard.

To prevent large machines being started too quickly by throwing the switch through all the positions without stopping on any one position, a ratchet device is provided on the 1200, 2400, and 3600-ampere switches.



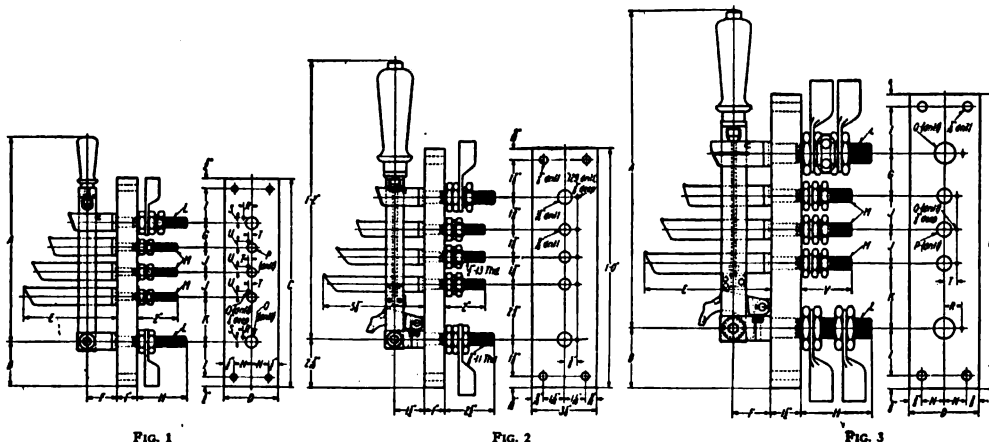
WITH RATCHET STOP

## RATINGS AND PRICES

Style number and list price include motor-starting switch with terminal lugs and arranged for mounting on panels from 1 1/4 to 2 inches thick, but do not include resistor or switch base.

Maximum Starting Current Amperes	Continuous Carrying Capacity Amperes*	APPROX. WT., LBS., WITH BASE		Style No.	Additional List Price for Slate Base, Including Mounting	List Price
		Net	Boxed			
300	75	10	12	201868	\$ 8 50	\$ 44 00
600	150	15	18	201869	9 50	72 00
1200	300	26	31	201870	11 00	125 00
2400	600	35	42	201871	14 00	155 00
3600	900	43	52	201872	17 00	210 00

\*30 degree Centigrade rise, or less.



Style No.	Fig. No.	DIMENSIONS IN INCHES CORRESPONDING TO LETTERS IN OUTLINE VIEWS																					
		A	B	C	D	E	F	G	H	I	J	K	L*	M*	N	O	P	Q	R	S	T	U	V
201868	1	3 3/8	2 1/4	9 1/2	2 1/2	3 3/4	1 1/4	1 1/4	2 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	.067	1/4	1/4	1/4	1/4	...
201869	1	10 1/4	2 1/4	10 1/2	2 1/2	4 1/4	1 1/4	1 1/4	2 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	.107	1/4	1/4	1/4	1/4	...	
201870	2	All dimensions are given on figure.																					
201871	3	16	3	14 1/2	3 1/2	6 1/2	1 1/4	2 1/4	3 1/4	2 1/4	1 1/4	3 1/4	1 1/4	1 1/4	1 1/4	1 1/4	.129	1/4	1/4	1/4	1/4	2 1/4	
201872	3	17 1/2	3 1/4	16 1/2	3 1/2	7 1/4	1 1/4	2 1/4	3 1/4	2 1/4	1 1/4	3 1/4	1 1/4	1 1/4	1 1/4	1 1/4	.194	1 1/4	1/4	1/4	1/4	3	

\*Diameter and threads per inch. These dimensions are for reference only. For official dimensions apply to the nearest district office.



## TYPE A FIELD SWITCHES

Rear-Connected—For Voltages up to 600

Two forms of field switches are listed, discharge (with discharge resistors) and transfer.

### Application

**Field-Discharge Switches**—Field discharge switches are used in the field circuit of generators to serve as a means of opening and closing the field circuit and, when the switch is opened, of making the necessary connections of the field winding to a resistor, so that the energy in the inductive field winding may be dissipated in the resistor instead of causing undue strain on its insulation.

**Field-Transfer Switches**—Field-transfer switches are used for transferring the field circuits of rotary converters or generators from one source of supply to another without opening the supply circuits, where there is not likely to be a difference of potential between the two supplies. Where such a difference is likely to occur, the transfer switch with additional jaws for inserting a limiting resistor between the supply circuits should be used (Fig. 1). They are used especially where it is necessary to transfer a rotary converter or a generator field circuit from the bus-bars to the armature for self-excitation or to a direct-connected exciter as with rotaries or synchronous motor-generator sets started from the direct-current side.

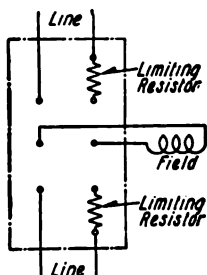


FIG. 1—DIAGRAM OF CONNECTIONS OF FIELD-TRANSFER SWITCH USING LIMITING RESISTORS

The single-pole switches are used particularly in railway service using grounded return.

### Operating Characteristics

**Temperature**—The current-carrying parts of these switches will carry their full rated current continuously with a maximum temperature rise of 30 degrees Centigrade above that of the surrounding atmosphere, corrections to be made when the temperature of the surrounding atmosphere is above 25 degrees Centigrade.

**Dielectric Test**—These switches are subjected for one minute to a dielectric test of 5000 volts between poles.

**Current Ratings**—The current ratings shown for the field switches listed are maximum, based on an allowable temperature rise that is reached after a continuous run of approximately one hour at the rated current.

### Operation

**Field-Discharge Switches**—Just before the knife blades of the switch leave the contact jaws, an

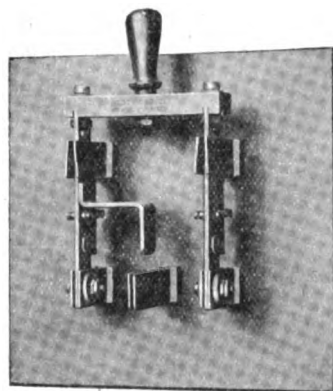


FIG. 2—FIELD-DISCHARGE SWITCH

auxiliary blade makes contact in such a way that the discharge resistor is connected across the field winding, thus allowing the inductive discharge of the field winding to die out gradually.

**Field-Transfer Switches**—The field-transfer switches are operated on the rocker principle with their blades so shaped that just before one side leaves the contact jaws the other makes contact with its jaws. Thus the field circuit is not opened.

### Construction

The field-discharge and field-transfer switches are of the standard Westinghouse type A rear-connected knife-switch construction. They have satin finish, are neat in appearance and very substantial and simple in design. All current-carrying parts are of the best hard-drawn copper.

The field-discharge switches have quick-break blades.

### Resistors

Resistors are listed for use with the field-discharge switches.

**Capacity**—In selecting a resistor for use with field-discharge switches select the ampere rating corresponding to the exciting current when the

TYPE A FIELD SWITCHES—Continued

generator with which it is used is delivering normal full load. The resistors are of a capacity sufficient to take care of the discharge when the generator is operating on overload.

Voltage—The voltages shown for resistors listed in this section are the normal excitation voltages; the resistors being applicable to exciting voltages 25 per cent below these values.

RATINGS AND PRICES

FIELD-DISCHARGE SWITCHES

Panel-Mounting

Style number and list price include switch complete without base or resistor ready for installation on base or panel.

Capacity Amperes	Poles	SINGLE THROW		DOUBLE-THROW	
		Style No.	List Price	Style No.	List Price
<b>For Voltages up to 250</b>					
100	1	284989	\$10 00	284990	\$13 75
100	2	284991	20 00	284992	27 50
200	1	285000	12 50	285001	17 50
200	2	285002	25 00	285003	35 00
400	1	285024	27 50	285025	38 25
400	2	285026	52 00	285027	72 50
600	1	285032	42 50	285033	54 50
600	2	285034	72 00	285035	109 00
800	1	285036	55 00	285037	74 00
800	2	285038	110 00	285039	148 00
<b>For Voltages up to 600</b>					
100	1	284993	13 75	284994	20 00
100	2	284995	27 50	284996	40 00
200	1	285004	17 50	285005	23 75
200	2	285006	35 00	285007	47 50
300	1	285016	38 25	285017	38 25
300	2	285018	72 50	285019	72 50

RESISTORS

For Use with Field-Discharge Switches

Style number and list price include resistor complete.

100 TO 150 VOLTS			200 TO 300 VOLTS			400 TO 600 VOLTS		
Normal Field Current, Amperes	Style Number	List Price	Normal Field Current Amperes	Style Number	List Price	Normal Field Current Amperes	Style Number	List Price
4-8	159091	\$4 30	4-8	159091	\$4 30	4-8	87652	\$18 00
8-11	159092	4 30	8-11	159092	4 30	8-11	87653	19 00
11-14	159093	4 30	11-14	159097	4 30	11-15	87654	20 00
14-20	159094	4 30	14-20	87643	11 00	15-22	87655	20 00
20-30	159095	4 30	20-30	87644	12 00	22-32	87656	26 00
30-40	159096	4 30	30-45	87645	12 00	32-42	87657	26 00
40-75	159098	4 60	45-80	87646	13 00	42-62	87658	28 00
75-100	159099	4 60	80-125	87647	14 00	62-75	87659	39 00
100-150	159100	6 00	125-170	87648	29 00	75-125	87660	41 00
150-250	159101	6 00	170-225	87649	30 00	125-200	87661	66 00
250-400	159532	26 00	225-275	87650	31 00	200-275	87662	81 00
.....	.....	.....	275-400	87651	43 00	275-400	87663	142 00

FIELD-TRANSFER SWITCHES

Style number and list price include switch complete without base.

Capacity Amperes	SINGLE-POLE		DOUBLE-POLE	
	Style No.	List Price	Style No.	List Price
<b>For Voltages up to 600 Without Limiting Resistor</b>				
60	289468	\$13 00	289469	\$23 00
100	289470	15 00	289471	30 00
200	289472	26 00	289473	46 00
400	.....	.....	289475	59 00
<b>For Use With Limiting Resistors*</b>				
100	230318	24 00	230319	37 00

\*Style number and price do not include resistors. Prices of resistors will be supplied on request. Specify voltage of supply circuits and the characteristics of the field.

Order by Style Number

TYPE A FIELD SWITCHES—Continued

OUTLINE DIMENSIONS

FIELD-DISCHARGE SWITCHES

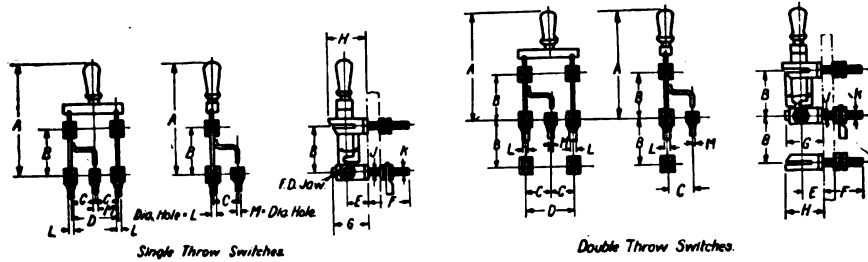


FIG. 3—PANEL MOUNTING

Panel-Mounting, Fig. 3

Amps.	Volts	DIMENSIONS IN INCHES											
		A	B	C	D	E	F	G	H	J	K	L	M
<b>For Voltages up to 250</b>													
100	250	6 1/2	3	1 1/8	3 3/8	1 1/2	3	2 1/8	2 1/4	3/4	3/4	.384	.384
200	250	7 1/8	3 1/2	1 1/8	3 3/4	1 1/8	3 1/2	2 1/8	3	3/4	3/4	.558	.384
300	250	8 1/4	3 3/4	2	4	2 1/4	3 3/4	3	3 3/8	3/4	3/4	.87	.384
400	250	9 1/4	4 1/4	2 1/4	4 1/2	2 3/4	3 3/4	3 1/8	4 1/8	3/4	3/4	.87	.558
600	250	10 1/4	4 3/4	2 1/4	4 3/2	2 3/4	4 3/4	4 1/8	4 1/2	3/4	3/4	1.28	.558
800	250	12 1/4	5 1/2	2 1/4	4 3/2	2 3/8	5 1/4	4 3/4	4 3/4	1	3/4	1.385	.558
<b>For Voltages up to 600</b>													
100	600	8 1/2	5	2 1/4	5 1/2	1 1/2	3	2 1/8	2 1/4	3/8	3/8	.384	.384
200	600	9 1/4	5 1/2	3	6	1 1/8	3 1/4	2 1/8	3	3/8	3/8	.558	.384
300	600	10 3/4	5 3/4	3	6	2 1/4	3 1/2	3 1/8	3 3/8	3/8	3/8	.87	.384

FIELD-TRANSFER SWITCHES

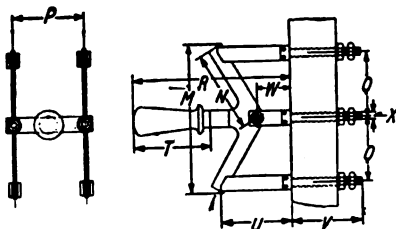


FIG. 4—STYLE NOS. 289468 TO 289473 AND 289475

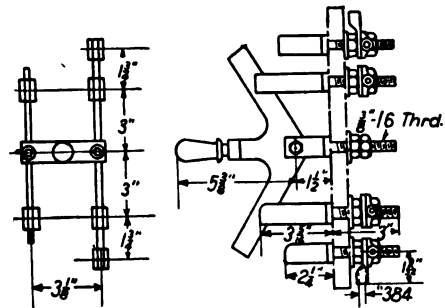


FIG. 5—STYLE NOS. 230318 AND 230319

Rating	Pole	DIMENSIONS IN INCHES—FIG. 4									
		M	N	P	Q	R	T	U	V	W	X
60	Single	6	3 1/4	...	2 3/8	4 1/2	1 3/8	2 1/8	3	1 1/8	1 1/8
100	Single	7 1/4	3 3/8	...	3	5 1/8	2	3 1/4	3	1 1/2	1 1/2
200	Single	8 3/4	4 1/4	...	3 1/2	7 3/8	2 1/2	4	3 1/4	1 3/4	1 3/4
60	Double	6	3 1/4	3	2 3/8	4 1/2	1 3/8	2 1/8	3	1 1/8	1 1/8
100	Double	7 1/4	3 3/8	3 1/4	3	5 1/8	2	3 1/4	3	1 1/2	1 1/2
200	Double	8 3/4	4 1/4	3 1/2	3 1/2	7 3/8	2 1/2	4	3 1/4	1 3/4	1 3/4
400	Double	10 3/4	5 1/2	4 3/8	4 1/4	7 3/8	3 3/8	4 1/4	3 3/4	1 3/4	1 3/4

These dimensions are for reference only. For official dimensions apply to nearest district office. For dimensions of remote-control switches apply to nearest district office.

## BACK-OF-BOARD TYPE KNIFE SWITCHES

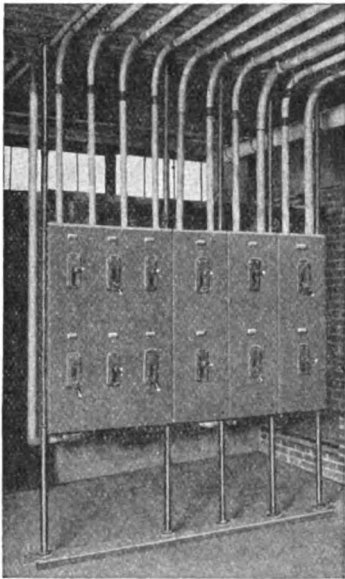


FIG. 1—BACK-OF-BOARD KNIFE SWITCH INSTALLATION

### Application

There is an increasing demand for safety in industrial and other installations such as office buildings, schools, etc., especially in cases when a large number of switches on the face of the panel emphasizes the hazard involved in using such switches.

Back-of-board knife and field-discharge switches have been designed to meet this demand.

As designed, the switch is a logical development from the front-of-board knife switch, and consists of a standard front-connected knife switch, or field discharge switch, mounted on a slate base which is itself secured to the rear of the panel by mounting brackets. The standard handle is omitted from the knife switch, and a lever is supplied which passes through a slot on the panel and operates the switch in the rear from the front of the panel.

### Distinctive Features

A novel feature of this design is shown in the double-throw switch, the mechanism for which is the same as the single-throw switch except that the handle is permitted to move through an angle approximately twice that of the single-throw switch, while the switch parts are standard.

Another novel feature of the switch is that it may be mounted on any thickness of panel by simply changing the length of the mounting bolts without any other adjustment whatever on the mechanism of the switch. The same bolts are used for attaching the coverplate and the mounting brackets to the panel.

### Construction

The method of construction makes the assembly of the switch an exceedingly simple matter for the customer. The lining up of the parts is done by expert assemblers, and to mount the switch on the panel all that is necessary is to remove the handle grip and pass the handle lever through the slot, then tighten up the bolts connecting the coverplate with the mounting bracket. The handle grip is then replaced.

The switch parts are of standard type A front-connected construction as described in the section of this catalogue on "Knife Switches."

**Finish**—Current carrying parts are supplied with a satin finish, although a polished finish can be furnished at an increase in price. The other metal parts, such as coverplates and brackets, are supplied with a dull black enamel finish.

**Bases**—The switch parts are furnished mounted on a black marine-finished slate base with mounting brackets attached. They are not furnished without bases.

For temperature rise, quick-break attachments and underwriter's approval see "Knife Switches."

### Instructions for Ordering

Style number and list price include switch with satin finish complete with slate base with black marine finish, bracket and mounting bolts for mounting on rear of switchboard, coverplate and handles with handle guides for operating from front of panel. Terminals are supplied for one stud per pole for single-throw switches and for two studs per pole for double-throw switches. Fuses are not furnished with the fused type of switch. When fuses are required, they should be ordered as separate items. (See pages listing fuses).

When terminals other than those included in the style number are required, they should be ordered as separate items. (See "Switchboard Details").

When switches are required with quick-break attachments, they should be ordered by referring to the style number of the switch without quick-break attachments, stating "same as Style No. . . . except to have quick-break attachments."

If other than standard size bases are required, they will be supplied at special prices.

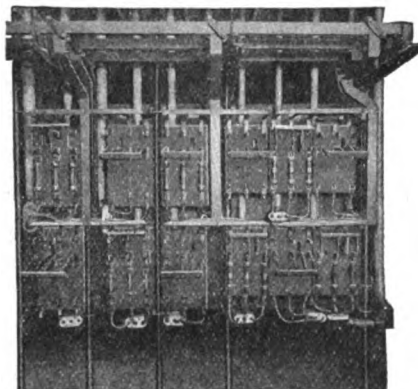


FIG. 2—REAR VIEW OF INSTALLATION SHOWN IN FIG. 1

Quotations on switches not listed may be obtained on application.

If 30 and 60-ampere fused switches are desired, they should be ordered by referring to the style number of the 100-ampere fused-type switch, except stating "same as Style No. . . . except arranged for 30- (or 60) ampere fuses." The price will be the same as that of the corresponding 100-ampere switch.

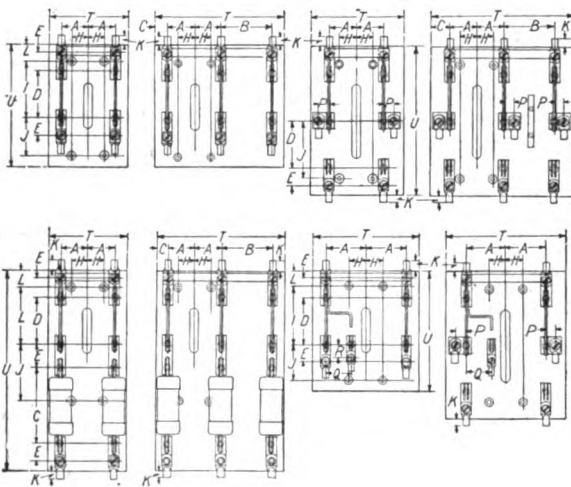
BACK-OF-BOARD TYPE KNIFE SWITCHES—Continued

Field-Discharge Switches

Table with columns for Amps., Style No., Net Wt., List Price for SINGLE-THROW and DOUBLE-THROW switches. Includes sub-sections for 250-Volt and 600-Volt.

For quick-break attachments add the following list price per pole per throw

Table showing additional List Price for quick-break attachments based on Amps. (100, 200, 400, 600).



Knife Switches

Table with columns for Amps., Style No., Net Wt., List Price for TWO-POLE and THREE-POLE switches. Includes sub-sections for 250-Volt D-C, 500-Volt A-C, and unfused switches.

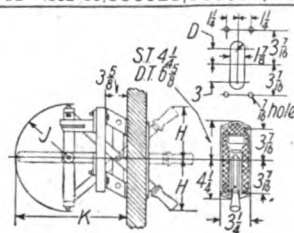


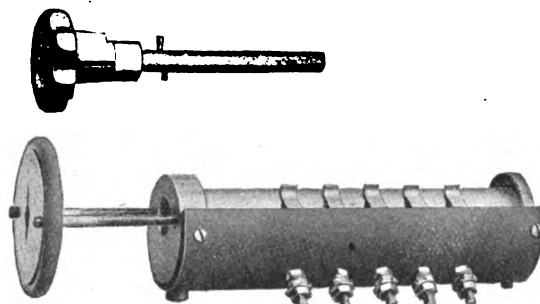
Table with columns for DESCRIPTION (Amps., Volts) and DIMENSIONS IN INCHES (H, J, K).

Large table with columns for STYLE No., DIAMETER IN INCHES (A-U), and Diam. of Bolt for Terminal / Diam. of Hole for Wire.

\*Operating lever located between middle and left-hand pole of switch viewed from coverplate side. †Operating lever located between middle and right-hand pole of switch viewed from coverplate side.

## INSTRUMENT SWITCHES

### TYPE RS DRUM-TYPE SWITCHES



VOLTMETER SWITCH AND KEY

#### Application

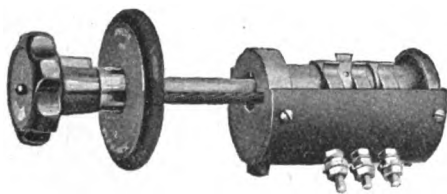
Type RS instrument switches are used for connecting one instrument to any one of several circuits and for making the multipoint connections required when synchronizing generators.

#### Operation

All type RS instrument switches, with the exception of the ammeter and thermo-couple switches, have removable keys or handles. These keys are labeled and constructed so that they cannot be inserted in the wrong switches.

**Ammeter Switch**—With one ammeter, one ammeter switch and two or more current transformers on a polyphase circuit, the ammeter can be connected so as to read the current in any phase. Switching contacts are so arranged that the current transformer secondary circuits are never opened.

Two forms of ammeter switches are listed. The two-phase and three-phase switches make the neutral connection in the switch, while the three-circuit and four-circuit switches keep the several circuits entirely independent. (Figs. 2 and 3.)



AMMETER SWITCH

**Thermo-Couple Switch**—With one switch per generator, the potentiometer or temperature indicator can be connected so as to read the temperature in any couple on any machine. (Fig. 4)

**Voltmeter Switch**—With one voltmeter switch for each polyphase circuit, one voltmeter, and, for service above 600 volts, the necessary potential transformers, the voltmeter can be connected so as to read the voltage on any phase of any circuit. (Fig. 5.) One key is required for each voltmeter

and its group of switches. If more than one group of voltmeter and switches is desired, each group can be supplied with a different key arrangement.

**Frequency Meter Switch**—With one frequency meter, the necessary potential transformers and one switch for each bus system, the frequency can be read on any bus system. (Fig. 5.) One key is required for each frequency meter.

**Wattmeter, Watthour Meter, Power Factor Meter and Reactive Factor Meter Switches**—With one instrument, one switch with proper labeling and key arrangement for each single or polyphase circuit, and the necessary instrument transformers, readings can be taken on any circuit. (Figs. 6, 7 and 8.) One key is required for each instrument.

**Synchronizing Switch for Synchronizing Between Machines**—With one synchronoscope equipment, one switch for each machine, and the necessary potential transformers, a synchronizing indication can be obtained between any two machines. (Fig. 9.) One **running key** and one **incoming key** are required. The running key is to be placed in the synchronizing switch of one of the machines running and can be turned in the running position only; the incoming key is to be placed in the synchronizing switch of the machine being brought in and can be turned in the incoming position only. Each switch has a running and an incoming position.

**Synchronizing Switch for Synchronizing Between Machine and Bus**—With one synchronoscope equipment, one switch for each generator on a single-bus system and two switches for each generator on a double-bus system and the necessary potential transformers, a synchronizing indication between the bus and any incoming machine can be obtained. (Fig. 10.) One key is required.

**Synchronizing Switches** are listed with and without interlock contacts for the closing circuit of electrically-operated circuit-breakers.

**Multi-Circuit Voltmeter Switches** are arranged to connect the meter to any one of a number of circuits.

INSTRUMENT SWITCHES—Continued

Construction

Strength and compactness are salient features of the type RS instrument switches. Movable contact members, securely mounted on a substantial micarta drum, engage with stamped contact fingers as the drum is rotated to the right or left. The switching element is housed in a substantial micarta tube. A segment of the housing is easily removable for inspection and adjustment.

**Finish**—The operating key is of black moulded material with a polished black finish; the dial-plate markings are polished copper on the raised parts with a black mat background; and the housing is finished in dull black.

Instructions for Ordering

Where switches are shown without keys the style number and list price include the switch complete. Where switches are shown with keys the switch style number and list price include the switch only without key; the necessary key or keys should be ordered extra by style number and at the list price shown.

**Spacers**—Switches are for two-inch panel mounting. On request the following spacers will be supplied without charge, one per switch.

Type of Switch	Thickness of Panel inches	Style No. of Spacer
All two-inch diameter switches	1 1/2	296162
	1 1/4	296835
Multi-Circuit Voltmeter switches	1 1/2	324048
	1 1/4	324049

Prices —Type RS Drum-Type Switches

Description of Switch	Fig. No.	Dimension A Inches Fig. 1	PANEL THICKNESS—2 INCHES			
			Switch Style No.	List Price	Key Style No.	List Price
Two-Phase Ammeter Switch	3 and 4	3 1/2	279054	\$13 00	*	*
Three-Phase Ammeter Switch		3 1/2	279056	12 00	*	*
Three-Circuit Ammeter Switch		6 3/8	279058	16 00	*	*
Four-Circuit Ammeter Switch		8 1/8	279060	22 00	*	*
D.C. Single-Pole Voltmeter Switch	6	4 1/8	279062	12 00	279102	\$2 00
A.C. Single-Pole Voltmeter Switch	6	4 1/8	279064	12 00	279104	2 00
D.C. Two-Pole Voltmeter Switch†	6	5 3/8	279066	13 00	279102	2 00
A.C. Single-Phase Voltmeter Switch, Two-Pole	6	5 3/8	279068	13 00	279104	2 00
A.C. Two-Phase Voltmeter Switch	6	7 1/8	279074	15 00	279114	2 00
A.C. Three-Phase Voltmeter Switch	6	6 3/8	279072	15 00	279112	2 00
D.C. Three-Wire Voltmeter Switch	6	7 1/8	279076	15 00	279116	2 00
Frequency Meter Switch	6	5 3/8	279070	10 00	279110	2 00
Polyphase Wattmeter or Watthour Meter Switch with Voltage and Current Contacts	7	5 3/8	279078	20 00	279118	2 00
Polyphase Wattmeter or Watthour Meter Switch with Current Contacts only	7	4	279084	16 00	279118	2 00
Power-Factor Meter Switch with Voltage and Current Contacts.§	8	5 3/8	279082	20 00	279122	2 00
Power-Factor Meter Switch with Current Contacts only	8	4	279088	16 00	279122	2 00
Reactive-Factor Meter Switch	9	5 3/8	279100	19 00	279130	2 00
Switch without Interlocks for Synchronizing Between Machines.....	10	4 3/8	279092	15 00	†279124	2 00
Switch with Interlocks for Synchronizing Between Machines					†279124	
Switch without Interlocks for Synchronizing to Bus	10	6 3/8	279094	16 00	279125	2 00
Switch with Interlocks for Synchronizing to Bus	11	6 3/8	279096	14 00	279128	2 00
Thermo-Couple Switch	11	7 7/8	279098	15 00	279128	2 00
Multi-Circuit Voltmeter Switch 4-Cir. D. P.	5	5 1/2	279090	15 00	*	*
Multi-Circuit Voltmeter Switch, 6-Cir. D. P.	2-12	6 1/8	298846	24 00	*	*
Multi-Circuit Voltmeter Switch, 8-Cir. D. P.	2-13	6 1/8	298847	25 00	*	.....
Battery-Charging Voltmeter Switch	2-14	7 5/8	298848	26 00	*	.....
	**	**	375007	15 00	*	.....

\*Separate keys not required.  
 †Two keys—one of each style are required for synchronizing between machines.  
 ‡This switch can be used as a single-pole 600-volt railway switch.  
 §Approximate weight of switch with key—net, 3 pounds; shipping, 5 pounds.  
 ¶If three voltage contacts are required, order reactive-factor meter switch with power-factor meter dial-plate at same list price as standard reactive-factor meter switches.  
 ¶These do not fit multi-circuit voltmeter switches. Spacers for same can be supplied on special orders.  
 \*\*Diagram of connections and dimensions will be furnished on request.

Order by Style Number

OUTLINE DIMENSIONS

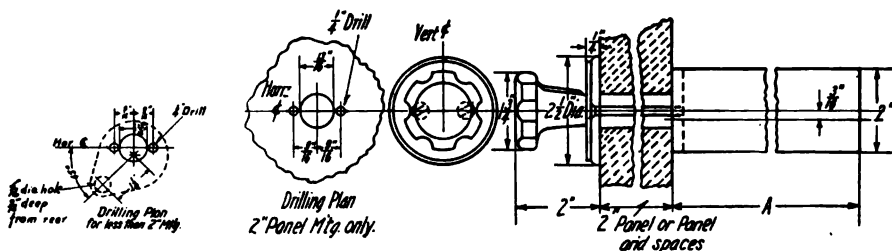


FIG 1—OUTLINE DIMENSIONS AND DRILLING PLAN FOR ALL EXCEPT MULTI-CIRCUIT VOLTMETER SWITCHES

These dimensions are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number

INSTRUMENT SWITCHES—Continued

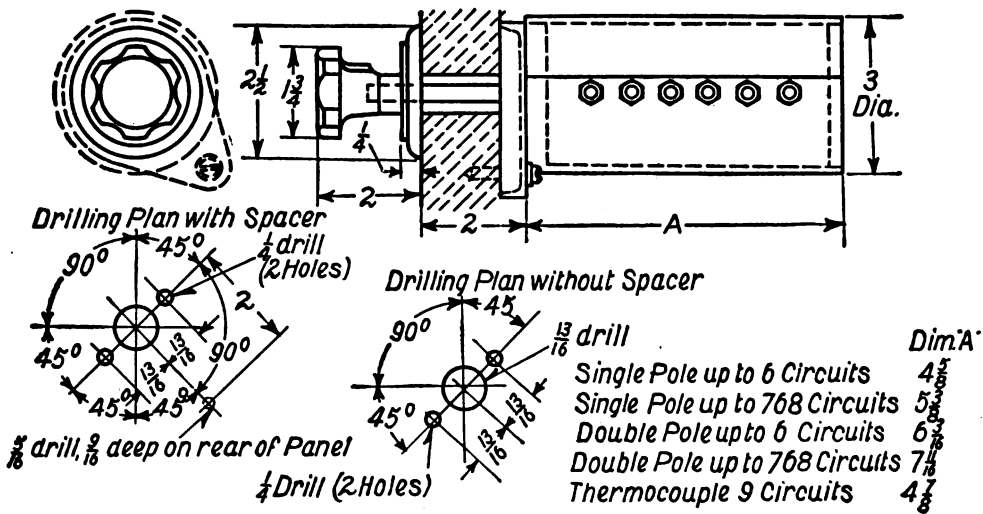


FIG. 2—OUTLINE AND DRILLING FOR MULTI-CIRCUIT VOLTMETER SWITCHES

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

DIAGRAM OF CONNECTIONS

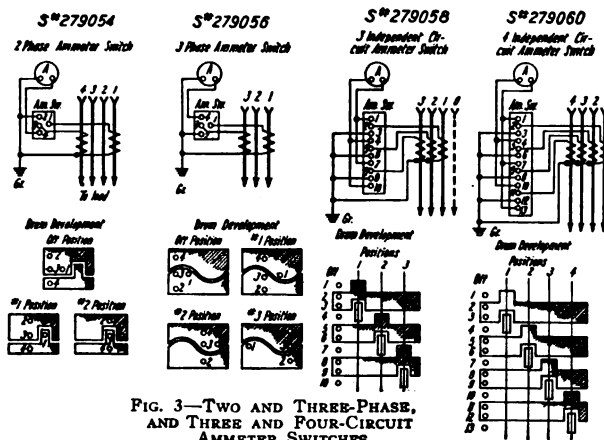


FIG. 3—TWO AND THREE-PHASE, AND THREE AND FOUR-CIRCUIT AMMETER SWITCHES

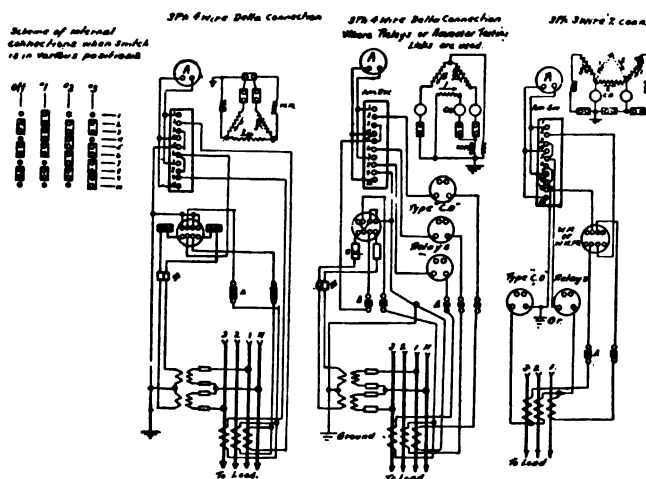


FIG. 4—SOME APPLICATIONS OF THE THREE INDEPENDENT CIRCUIT AMMETER SWITCH, STYLE NO. 279058, THE AMMETER BEING USED IN CONNECTION WITH OTHER INSTRUMENTS



INSTRUMENT SWITCHES—Continued

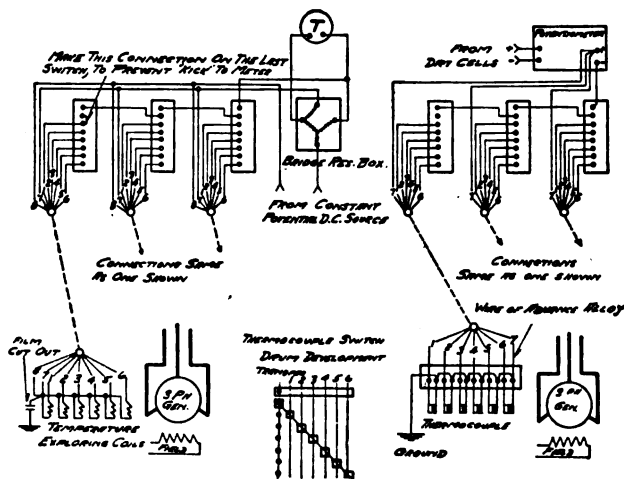


FIG. 5—THERMO-COUPLE OR POTENTIOMETER SWITCHES STYLE NO. 279090

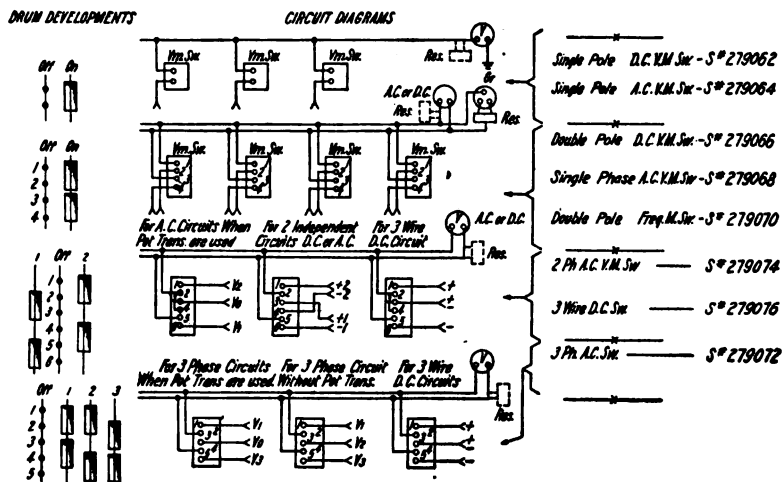


FIG. 6—A-C. AND D-C. VOLTMETER AND FREQUENCY METER SWITCHES

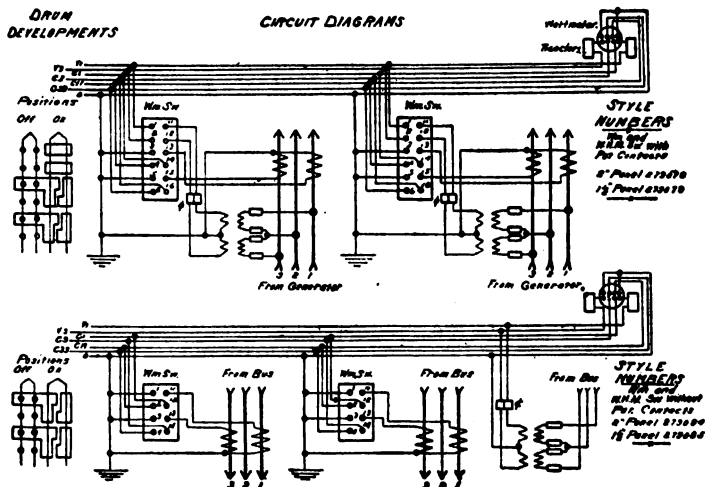


FIG. 7—WATTMETER AND WATTHOUR METER SWITCHES

INSTRUMENT SWITCHES—Continued

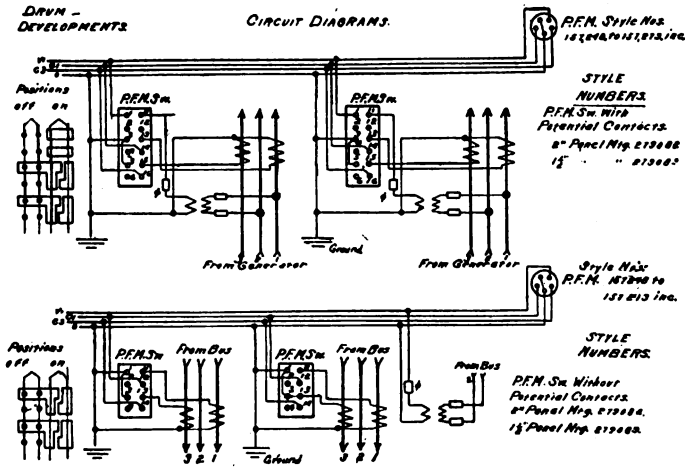


FIG. 8—POWER-FACTOR METER SWITCHES (ONE VOLTAGE COIL AND TWO CURRENT COILS).

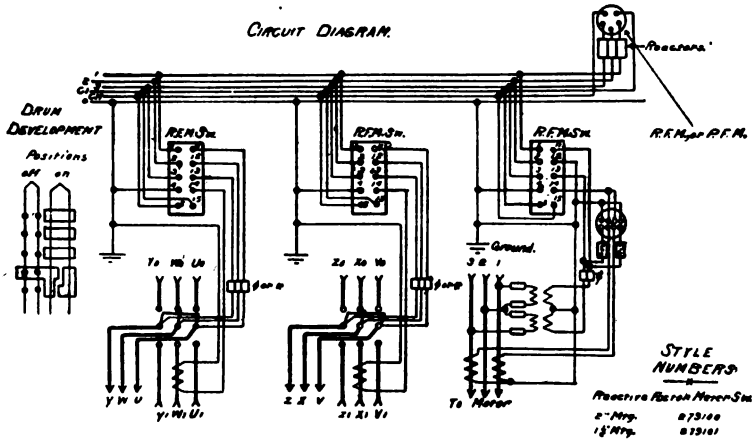


FIG. 9—REACTIVE-FACTOR AND POWER-FACTOR METER SWITCHES See note on page 202 for Power-Factor Meter Switch indicated by \*\*

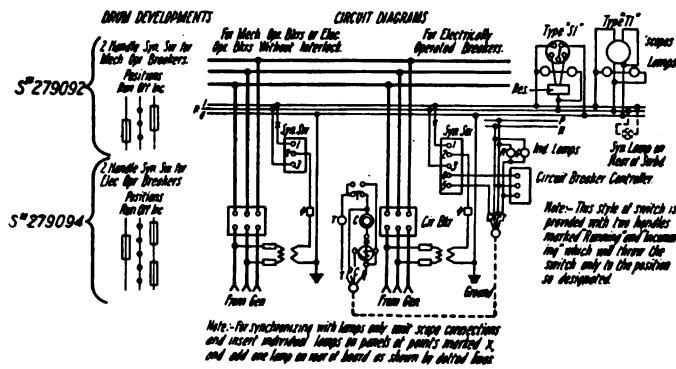


FIG. 10—SYNCHRONIZING SWITCH FOR SYNCHRONIZING BETWEEN MACHINES

INSTRUMENT SWITCHES—Continued

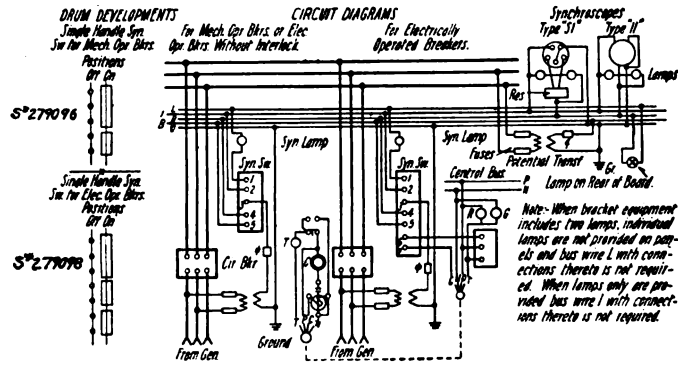


FIG. 11—SYNCHRONIZING SWITCH FOR SYNCHRONIZING BETWEEN BUS AND ANY MACHINE

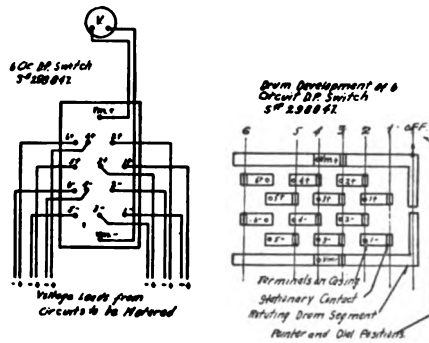


FIG. 12—MULTI-CIRCUIT VOLTMETER SWITCH, 4-CIRCUIT, 2-POLE

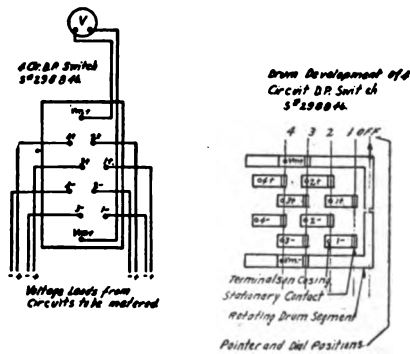


FIG. 13—MULTI-CIRCUIT VOLTMETER SWITCH, 6-CIRCUIT, 2-POLE

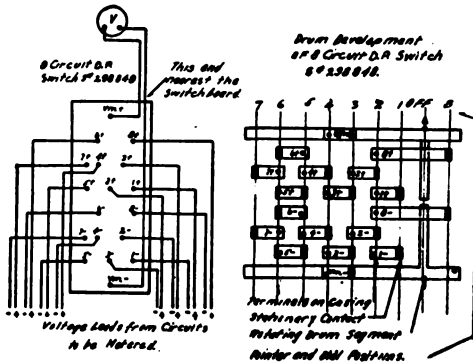


FIG. 14—MULTI-CIRCUIT VOLTMETER SWITCH, 8-CIRCUIT, 2-POLE

## MOTOR-OPERATED SNAP SWITCH

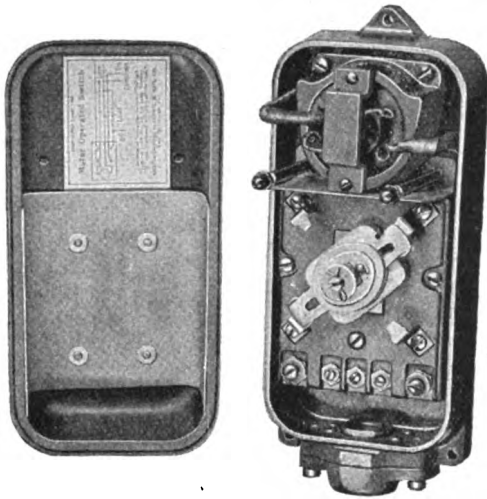


FIG. 1—MOTOR-OPERATED SNAP SWITCH

### Application

Motor-operated snap switches are applicable wherever the automatic operation of electrical devices is desired. They can be operated by any mechanism that will transfer the external connection as shown in Fig. 2. Mechanisms, such as thermostats, pressure gauges, time clocks, and floats can be used for this purpose. A few of these applications are given here.

**With thermostats** these switches can be used: to regulate electric heaters for heating water, oil or other liquids, or for evaporating syrups; to control the motor that operates the brine pump in either domestic or commercial refrigerators; to regulate the temperature in electric ovens used for baking, fruit drying, or for industrial purposes.

**With pressure gauges** they can be used to regulate the amount of current or gas fed to boilers.

**With time clocks** the application of these switches is unlimited. Electric signs, street lamps, store window lights, and whistles are some of the applications. In the factory they are especially useful when applied to electrical devices that should be started before the working day, such as forges and pre-heat furnaces, solder, die-casting, glue and wax pots.

**With floats** they can be used to regulate the height of liquid in tanks.

### Distinctive Features

Entire mechanism is mounted on a substantial casting.

Motor can be used on alternating or direct current.

Motor bearings are special, self-lubricating material.

Power consumption is low.

### Operation

The motor-operated snap switch consists of a heavy snap switch with a motor geared to the switch shaft. The switch and motor are interconnected as shown in the wiring diagram, Fig. 2. The diagram is a typical one showing the switch and thermostat arranged to control an electric water heater. As shown in this diagram the heater is not on the line. When the thermostat closes the switch-motor circuit the motor throws the snap switch into the position opposite that shown, putting the heater on the line and at the same time opening the circuit of the switch motor. The next operation of the snap switch again opens the heater circuit and switch-motor circuit. The motor is on the circuit but a very short time at each operation and draws .4 of an ampere at either 110 or 220 volts.

**Test Data**—These switches have been operated at 220 volts, 20 amperes up to 20,000 operations without failures. Overload tests have been made up to 50 amperes with a resistance load on 220-volt circuits operating the switch about 6 times per minute for 100 operations. The circuit opened every time.

A switch was used to start a two horsepower, 220-volt, 60-cycle, single-phase, six-pole repulsion motor, which drew 71 amperes line current at 55 per cent power factor when locked. Under these conditions a test was made at six operations per minute for 50 operations and no failure to open the circuit occurred. No burning of the contacts was visible.

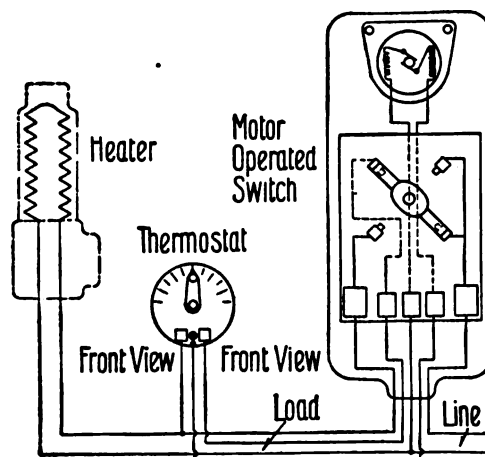


FIG. 2—WIRING DIAGRAM OF SWITCH AND THERMOSTAT ARRANGED TO CONTROL AN ELECTRIC WATER HEATER

### Construction

The switch contacts and moving parts are mounted on a porcelain base which is mounted in the cast-iron base on three bosses. The intermediate gears between the motor and the switch shaft are mounted on the floor of the base casting, and the motor is a unit mounted on the base casting.

## MOTOR-OPERATED SNAP SWITCHES—Continued

The switch parts with the ratchet mechanism are the Krantz Manufacturing Company's snap switch parts which have the Underwriters' approval for 30 amperes, 250 volts.

The motor is of the series type which can be used on alternating or direct-current circuits: that is, the armature and field coils are connected in series. The frame and field poles are cast-iron. The bearings are special self-lubricating material. The armature has five slots and the commutator five bars which assure ample starting torque and no dead spots.

The cover is cast-iron, lined with insulating material to prevent any possibility of the grounding of the contacts. It is held on the switch base by two studs and cap nuts.

A conduit adapter for  $\frac{3}{4}$ -inch conduit is attached to the end of the base castings by two screws. This provides a ready means of attaching the switch after the wires have been drawn in place. The switch adapted for panel mounting has an opening in the back of the base below the terminal

connections to allow the wires to go through to the rear of the panel. There is no conduit connection provided on this switch.

Several capacities of switches are furnished as listed below. The switch parts and the motors are the same in all of these switches but the strength of the switch spring and the resistance of the resistance tubes used in series with the motors is varied to give correct operation on the rated frequency and voltage as listed. 110-volt switches will operate up to 125 volts and 220-volt switches up to 250 volts.

Switches rated d-c. or 60 cycles have a small terminal block on the motor frame. This block permits connections to be made as per the diagram in the switch cover and makes it possible to use the switch on direct current or 60-cycle alternating current.

Where the frequency and voltage are definitely known, the switch without the terminal block on the motor can be ordered eliminating the necessity of changing any connections.

## PRICES

Style number and list price include the motor operated switch complete without any auxiliary de-

vices. In the case of the 250-volt switch the resistance is included.

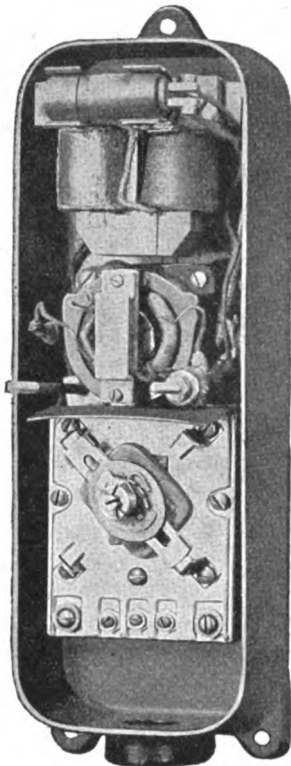
Volts	Frequency	MAXIMUM AMP. CAPACITY		Approximate Shipping Weight Pounds	Style No.	List Price
		A-C.	D-C.			
110	d-c. or 60 cycles	30	30	8	300329-A	\$24 50
220	d-c. or 60 cycles	20	15	8	300330-A	24 50
110	d-c. or 29 cycles	30	30	8	329181	24 50
110	30 or 60 cycles	30	..	8	329182	24 50
220	d-c. or 29 cycles	20	15	8	329183	24 50
220	30 or 60 cycles	20	..	8	329184	24 50
110)	d-c. or 60 cycles	(30	30)	8	363409	24 50
220)		(20	15)			
110)*	d-c. or 60 cycles	(30	30)	8	363410	24 50
220)*		(20	15)			

\*Adapted for panel mounting with leads to enter from the rear.

NOTE—For higher voltage motor-operated snap switches refer to the Company.

NOTE—For style numbers of motor-operated snap switch complete with thermostat, refer to pages of this catalogue on Automatic Temperature Control.

## AUTOMATIC TEMPERATURE CONTROL



REGULATING APPARATUS OF SOLDER POT TEMPERATURE REGULATOR

The automatic temperature control is primarily designed and intended to maintain the temperature of a given location at some predetermined value. By the use of this control, the cost of maintaining a desired temperature is materially reduced, and a much more satisfactory temperature medium is maintained. The controls described herewith are designed to function in conjunction with electrically operated mechanisms. Various modifications of the control may be supplied for temperatures up to 350° C.

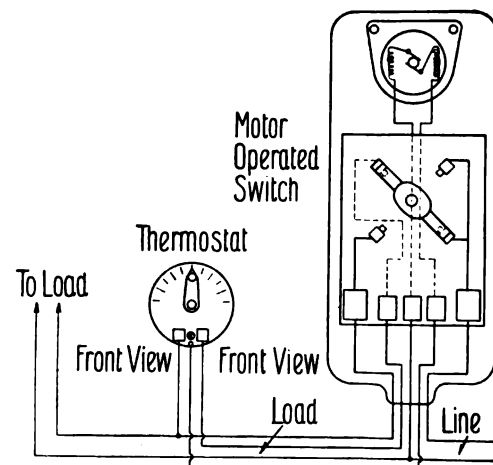
The automatic temperature control, as supplied, consists of a thermostatic regulator and a motor-operated snap switch. The motor-operated snap switch is described elsewhere in this catalogue and the ratings found there apply to an installation of this type.

The thermostatic regulator consists of a flat spiral bimetallic spring which revolves a shaft upon a change in temperature. This shaft has a contact arm rigidly attached to it which is adapted to move between two stationary contacts. Sputtering or

frying of the contacts is eliminated by the use of a small permanent magnet which insures a firm and positive contact between either stationary contact and the contact arm. The strength of the magnet and the construction of the thermostat is such that the zone of regulation is not increased by this magnetic action. A pointer which is adjustable over a dial, calibrated in degrees temperature, serves to adjust the bimetallic spring for the temperature at which the control is to regulate. The contact base, pointer, and bimetallic spring with their supporting parts are mounted in a cast iron case with the cover held in place by two small screws. Various modifications of this case are supplied, depending upon the application for which the control is intended.

The diagram of connections shows a typical wiring layout. It will be noted that while only one side of the line is opened, the internal connections of the motor-operated snap switch are such that successive "on" and "off" positions of the switch blades are obtained by alternate closing of the thermostat contacts. This alternate closing of the thermostat contacts is obtained by the movement of the contact arm which is under the influence of the temperature-sensitive bimetallic spring.

It will be seen that the outstanding features of this regulator are simplicity in construction, installation and operation. The performance under service is highly satisfactory. This control, when properly installed, will endeavor to regulate the ambient temperature for a given setting within plus or minus 2° C.



WIRING DIAGRAM OF SWITCH AND THERMOSTAT ARRANGED FOR TEMPERATURE CONTROL

## AUTOMATIC TEMPERATURE CONTROL—Continued

**AUTOMATIC TEMPERATURE REGULATOR FOR REFRIGERATORS**

(Consisting of Thermostat and Motor-Operated Snap Switch)

Temperature Range 10° to 100° F.

Volts	Maximum Capacity of Switch	Approximate Shipping Weight	Style No.	List Price
110	30 amp. a-c. or d-c.	12 lbs.	321173	\$31 00
220	20 amp. a-c.—15 amp. d-c.	12 lbs.	321174	31 00

**AUTOMATIC TEMPERATURE REGULATOR FOR WATER HEATERS**

(Consisting of Thermostat and Motor-Operated Snap Switch)

Temperature Range 130° to 210° F.

This regulator may also be applied to glue and gum pots, and also to low temperature drying ovens.

Volts	Maximum Capacity of Switch	Approximate Shipping Weight	Style No.	List Price
110	30 amp. a-c. or d-c.	12 lbs.	311726	\$31 00
220	20 amp. a-c.—15 amp. d-c.	12 lbs.	315357	31 00

**AUTOMATIC TEMPERATURE REGULATOR FOR BAKE OVENS**

(Consisting of Thermostat and Motor-Operated Snap Switch)

Temperature Range 375° to 550° F.

This regulator may be applied to air dryers, enameling ovens, etc., and may be supplied in temperatures up to 650° F. The application for which the regulator is intended should be stated when ordered.

Volts	Maximum Capacity of Switch	Approx. Shipping Weight	Style No.	List Price
110	30 amp. a-c. or d-c.	12 lbs.	372540	\$31 00
220	20 amp. a-c.—15 amp. d-c.	12 lbs.	372541	31 00

**IMMERSION TYPE TEMPERATURE REGULATOR**

(Consisting of Immersion Thermostat and Motor-Operated Snap Switch)

Temperature Range 130° to 210° F.

The thermostatic element of this regulator is mounted on a tube,  $\frac{5}{8}$  x  $8\frac{1}{2}$  inches, and is arranged to be screwed in the side of a tank. This regulator is especially applicable to oil baths, candy kettles, etc. The standard temperature range is 130° to 210° F. However, the regulator may be supplied in various ranges up to 300° F.

Volts	Maximum Capacity of Switch	Approximate Shipping Weight	Style No.	List Price
110	30 amp. a-c. or d-c.	12 lbs.	372537	\$31 00
220	20 amp. a-c.—15 amp. d-c.	12 lbs.	372538	31 00

**SOLDER POT TEMPERATURE REGULATOR**

(Consisting of Salt Thermostat and Case Containing Regulating Apparatus)

Temperature Range Approx. 490° to 520° C.

This regulator consists of a salt thermostat suitable for mounting in the top of a solder pot and a regulator case which embodies the motor-operated snap-switch, a small transformer and a thermal relay. The regulator is adjusted to regulator within 30° C. and is normally set to operate at approx. 500° C. Diagram of connections and instructions for operating are supplied with each regulator.

	Style No.	List Price
Salt Thermostat for 150 lb. pot.	356436	*
Salt Thermostat for 300 lb. pot.	357258	*
Salt Thermostat for 750 lb. pot.	357257	*

The above style numbers include the holder and thermostat.

	Style No.	List Price
Regulating element for 220 Volts 25 Cycles	323965	*
Regulating element for 220 Volts 60 Cycles	323967	*
Regulating element for 110 Volts 25 Cycles	323966	*
Regulating element for 110 Volts 60 Cycles	323968	*

\*Prices on Request.

**SPECIAL APPLICATIONS**

It is evident that various applications and modifications of the above regulators may be supplied. Information on any specific temperature regulating problem will be supplied on request.

## CARTRIDGE-TYPE THERMAL RELAYS



The cartridge type of thermal relay was primarily designed to protect small motors and electrical apparatus. The relay is calibrated to carry approximately 110 per cent of its rating continuously and to trip out on 125 per cent of its rating in a given time. The relays are calibrated at an ambient temperature of 25° C., and if the ambient temperature varies widely from this, the relay will trip

out in either a shorter or longer time, depending on whether the relay is operating in a higher or lower ambient temperature. This change in tripping time is in a direction to further protect the apparatus and inasmuch as the heating characteristics of the relay follow closely those of the apparatus it is protecting, the relay affords adequate protection at all times.

These relays may be supplied in both circuit-opening and circuit-closing types. In ordering, the terminal ampere rating of the motor should be given. This rating will give a 10 per cent overload capacity to the motor. If it is desired to operate the motor under a heavier overload, larger relays should be ordered. For example, if it is required to operate the motor continuously at 25 per cent overload, then thermal relays of a capacity 25 per cent greater than the terminal ampere rating of the motor would be required. The contact rating of these relays is as follows:

- 3 amperes 110 volts a-c.
- 1 ampere 600 volts a-c.
- 5 ampere 110 volts d-c.
- .25 ampere 250 volts d-c.

### Small Cartridge-Type Thermal Relay 1 to 35-Ampere-Rating

The diameter of the small cartridge-type thermal relay is such that it will fit the standard 60-ampere 250-volt fuse clip. However, the distance between ferrules is such that the relay and fuse are not interchangeable. This relay will operate on 200 per cent of its rating in approximately 50 seconds. This relay may be supplied in ratings from 1 to 35 amperes, as listed below.

Style No. Circuit-Opening	Style No. Circuit-Closing	Ampere Rating	List Price	Style No. Circuit-Opening	Style No. Circuit-Closing	Ampere Rating	List Price
372318	372342	1	\$1 75	372330	372354	9	\$1 75
372319	372343	1½	1 75	372331	372355	10	1 75
372320	372344	2	1 75	372332	372356	12	1 75
372321	372345	2½	1 75	372333	372357	15	1 75
372322	372346	3	1 75	372334	372358	17½	1 75
372323	372347	3½	1 75	372335	372359	20	1 75
372324	372348	4	1 75	372336	372360	22½	1 75
372325	372349	4½	1 75	372337	372361	25	1 75
372326	372350	5	1 75	372338	372362	27½	1 75
372327	372351	6	1 75	372339	372363	30	1 75
372328	372352	7	1 75	372340	372364	32½	1 75
372329	372353	8	1 75	372341	372365	35	1 75

### Large Cartridge-Type Thermal Relay 35 to 60-Ampere Ratings

The diameter of the large cartridge-type thermal relay is such that it will fit the standard 60-ampere 600-volt fuse clip. However, the distance between ferrules is such that the relay and fuse are not interchangeable. This relay will operate on 200 per cent of its rating in approximately 75 seconds. This relay may be supplied in ratings from 35 to 60 amperes, as listed below.

Style No. Circuit-Opening	Style No. Circuit-Closing	Ampere Rating	List Price
372381	372213	35	\$2 20
372382	372214	40	2 20
372383	372215	45	2 20
372384	372216	50	2 20
372385	372217	55	2 20
372386	372218	60	2 20

### Knife-Blade-Type Thermal Relays 65 to 100-Ampere Ratings

This relay is arranged for mounting in the standard 100-ampere 250-volt knife-blade holders. However, the spacing between knife blades is such that the relay and fuse are not interchangeable. This relay may be supplied in ratings from 65 to 100 amperes, as listed below.

Style No. Circuit Opening	Style No. Circuit-Closing	Ampere Rating	List Price
372391	372219	65	\$3 50
372392	372220	70	3 50
372393	372221	75	3 50
372394	372222	80	3 50
372395	372223	85	3 50
372396	372224	90	3 50
372397	372225	95	3 50
372398	372226	100	3 50



## DISCONNECTING SWITCHES

### GENERAL

Disconnecting switches are used primarily for isolating apparatus from the circuit for purposes of inspection and repair; also for sectionalizing feeders. In connection with lightning arrester installations disconnecting switches are particularly useful, providing a simple and effective means for isolating the arresters while cleaning and inspecting.

They are supplied in single-pole hook-stick form, either in single or double-throw form, or as double-throw selector-type switches, and in three-pole, single-throw, remote-control form. Selector type disconnecting switches permit the transfer without interruption of circuit. They have two blades, both of which latch on either throw. The continuous rating of each blade is half that of the switch.

**Temperature**—The current-carrying parts of Westinghouse disconnecting switches will carry their full-rated current continuously with a maximum temperature rise of either 20 or 30 degrees Centigrade above the temperature of the surrounding atmosphere, depending on the class of service as mentioned below into which the switches are placed.

It is necessary that adjacent apparatus does not heat the switch; that conductors to the switch are ample to carry the current with a temperature rise not exceeding that of the switch; and that reasonable ventilation is provided.

The 20-degree rise basis is recommended when the maximum temperature of the air where the switch is located may approximate 40 degrees Centigrade, and the load is practically continuous as on generator, rotary, or transformer circuits.

The 30-degree rise basis is recommended where maximum temperature of the air where switch is located may approximate 30 degrees Centigrade or less, and the load is intermittent as on feeder circuits.

**Insulation Test**—All Westinghouse disconnecting switches are subjected to a dielectric dry test, of  $2\frac{1}{4}$  times rated voltage plus 2000 volts, for one minute between conducting details and ground and between terminals, in accordance with A.I.E.E. rules. Switches for outdoor service will withstand a dielectric wet test of 2 times rated voltage plus 1000 volts. All switches up to 73,000 volts inclusive have been given a maximum voltage rating. Above this voltage switches may be successfully used at 5 per cent above the normal voltage rating given.

**Rating**—The maximum current for 5 seconds passing through disconnecting switches should not be greater, owing to mechanical and electrical

limitations, than 50 times their normal 60-cycle, 20-degree ampere rating. If the switches will be subjected to greater current for 5 seconds than this, switches of larger normal rating (amperes) should be used as they are both mechanically and electrically stronger.

The disconnecting switches listed herein are rated on the basis of 60-cycle alternating-current. When used on 25-cycle alternating-current service, the switches will have a rating corresponding to the same rated (amperes) type A knife switches.

**Application of rating**—In selecting a disconnecting switch, it is recommended that the rated capacity should be at least as great as the maximum rated one-hour (or more) overload current of all the apparatus supplied by the circuit in which the switch is to be placed.

**Operation**—Direct control switches are opened and closed with a hook on the end of a wooden pole, which engages in a hole in the switch blade or in a lock on switches supplied with locks.

Remote control switches are operated with a hand mechanism and removable wood handle which may be supplied with a spring bumper if desired. This spring bumper works to overcome the reaction tending to injure the insulators or working parts of the switch.

**Disconnecting switches are not intended to be opened while under load and therefore no attempt should be made to open them with current in the circuit.**

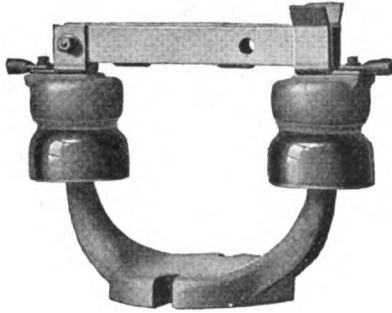
### Types

**Type M** disconnecting switches are single-pole, single-throw, indoor hook-stick operated switches for wall mounting and are listed in two capacities, 100 and 300 amperes, for 7500 and 15,000 volts.

**Type S** disconnecting switches are for indoor mounting only. They are listed in the front-connected form for voltages up to and including 73,000 volts and in the rear-connected form or combinations of front and rear-connected form, for voltages up to and including 25,000 volts, single and double-throw and selector type, single-pole hook-stick operation.

**Type R** disconnecting switches are designed for outdoor service conditions but are also applicable for indoor work at increased voltage ratings. They are furnished in single-pole form for inverted mounting up to 110,000 volts and in vertical mounting up to 37,000 volts.

## DISCONNECTING SWITCHES—Continued

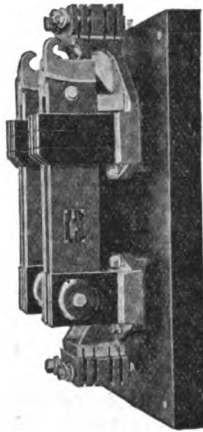


TYPE M 100-AMPERE, 7500-VOLT WALL-MOUNTING UPRIGHT INDOOR DISCONNECTING SWITCH

## TYPE M DISCONNECTING SWITCHES

The type M switches listed represent an incomplete line of low-priced disconnecting switches for indoor mounting. The live parts are mounted on porcelain insulators carried on an iron yoke. The switches are furnished without locks and all parts except the porcelain insulators are finished in dull black.

## TYPES S AND R DISCONNECTING SWITCHES



3000-AMPERE, 2500-VOLT, SINGLE-THROW, FRONT-CONNECTED, TYPE S SWITCH

## Distinctive Features

These disconnecting switches are of simple construction, rugged design and maximum strength.

The switch is equipped with a lock that is absolutely dependable.

The lock cannot fail thermally because it carries no current.

The lock is not supported by, and is separate, mechanically, from the break jaw, so that possible spreading of the jaw blades cannot unlock it.

The hinge jaw blades are solid (not split) preventing the hinge bolt from pulling out with a resultant opening of the circuit at the hinge jaw.

The hinge and break jaws are permanently sweated and pinned to the jaw blocks.

An insulator with its fittings forms an individual unit which may be carried in stock.

The fittings are cemented to the insulator to give the strongest possible construction.

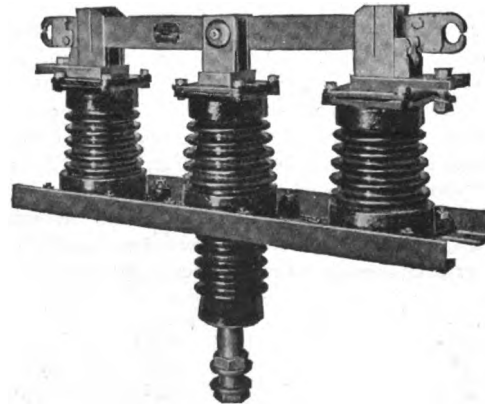
Ample cross section of copper parts and rugged construction of all fittings ensure the full utilization of all other distinctive features.

## Construction

**Blades**—The blades are single bars for the low voltages, and are clipped, braced, and reinforced to give rigidity for the higher voltages.

Two single blades are used on all 2000-ampere type S switches, and two pairs of single blades on all 3000-ampere type S switches. A single blade is used on all other sizes of switches up to and including the 7500-volt switches, on all 15,000-volt types switches and on the 600, 1200, and 2000-ampere, 15,000-volt type R switches. On the 200 and 400-ampere, 15,000-volt type R switches, on the 200 and 400-ampere 25,000-volt type S switches and on all types R and S switches above these voltages a truss or V-shaped blade is used. This blade is very rigid because of its broad base.

All selector-type switches have two blades, each blade having half the rating of the normal rating of the switch. Where it is desired to transfer the load from one bus to another bus without interrupting the circuit, one blade is drawn at a time. Because the 2000-ampere switches have two blades, and the 3000-ampere switches have two pairs of blades (each blade or pair of blades rated at half the normal rating of the switch) the switches of these capacities, listed in the table as double-throw switches, can also be used as selector switches.



800-AMPERE, 15,000-VOLT, SELECTOR-TYPE SWITCH

DISCONNECTING SWITCHES—Continued

**Jaws**—The break jaws for the higher voltage switches are equipped with guides to lessen the blow on the jaw blade of the switch as it closes. The hinge jaw blades are solid instead of slotted to prevent the pulling out of the hinge bolts and consequent opening of the switch during severe short circuits. The jaws are sweated and pinned permanently into the jaw block.

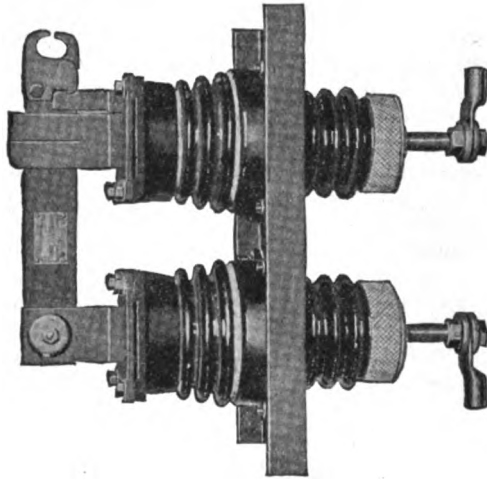
**Lock**—On all type S and type R disconnecting switches of 15,000 volts and less the lock is securely fastened to the end of the blade and snaps firmly into the locking position when the switch closes.

The lock is released and the switch opened by a single movement of the hookstick. The lock does not carry current so there is no danger of it becoming heated and releasing the switch blade. The lock is not supported by the jaws so that spreading of the jaws under short-circuit currents will not unlock the switch. In case this locking feature is not desired, a plate having a hole for a hook can be furnished. This plate, which bolts to the end of the blade, can later be removed and a latch part added.

Disconnecting switches, unless locked, are likely to open under short circuits if they are on a line whose short-circuit current is too high. In the following table is given the maximum current in amperes that can be carried by unlocked type S or R disconnecting switches without danger of opening the circuit. If the short-circuit current of the line is any greater than these values the switch with the lock must be supplied.

Switch Rating in Amperes	Maximum Short-Circuit Current in Amperes for Disconnecting Switches Without Locks
200	9000
400	12000
600	15000
800	17000
1200	20000
2000	27000
3000	32000

In the type R switch over 15,000 volts, the finger type of latch is used and switches are always furnished with this locking device. This is shown in the illustrations on page 96.



600-AMPERE, 7500-VOLT, HEAVY-DUTY, REAR-CONNECTED, TYPE S SWITCH

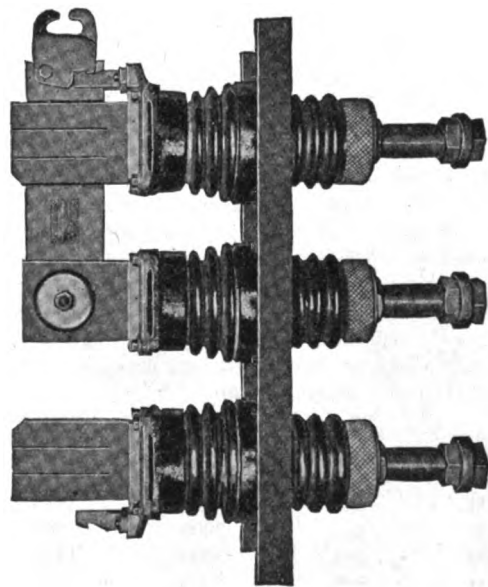
TYPE S DISCONNECTING SWITCHES

Distinctive Features

**Insulators**—The insulators have a large head and a broad base to secure maximum strength. The corrugations are shaped so as to give a long creepage surface, a great flashing distance, and a form that does not chip easily so that the insulators can be handled with minimum breakage. A very high factor of safety for the flashing distance is used in the design of the insulators for the low voltages, because the voltage surges at these voltages are higher in proportion than at the higher voltages.

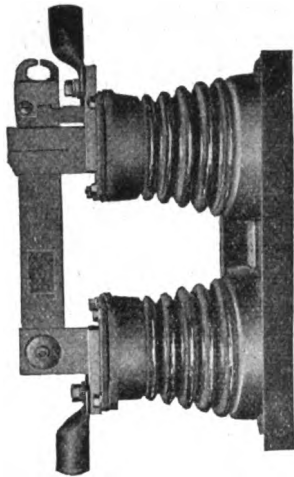
On the 2500-volt switch the live parts are mounted on a marble base or panel. For the 7500 and higher voltage switches the live parts are held by corrugated porcelain insulators on which top and bottom caps are cemented.

The insulators are assembled so that the pillar-mounting bolt holes in the bottom fitting line up with the contact bolt holes in the upper fitting, making the pillars interchangeable and readily removable from the base and the contact parts. The contact details are bolted to the top cap so that they are readily removable for repair or replacement. Each insulator, with its fittings, forms an individual



TYPE S, 1200-AMPERE, 7500-VOLT, DOUBLE-THROW STANDARD-DUTY, DISCONNECTING SWITCH, REAR-CONNECTED

## DISCONNECTING SWITCHES—Continued



TYPE S 600-AMPERE, 15,000-VOLT DISCONNECTING SWITCH—FRONT-CONNECTED

unit, which may be carried in stock by the customer. This construction facilitates adjustment and replacement.

Cementing the fittings to the insulators gives the strongest possible construction. Commercial porcelain cannot be made sufficiently uniform for the proper fitting of mechanical clamps without cement, so that they will withstand the strain resulting from the operation of the switch.

Above the 2500-volt size, these switches are divided into two forms, one for standard duty and the other for heavy duty. The standard duty switch has a smaller based insulator than the heavy duty switch, and is intended for use in small and medium sized power plants and in sub-stations. The heavy duty switches are intended for large power plants where severe stresses may be set up between switches or in the blade of the switch, due to magnetic effects under short-circuit conditions. The smallest switch shown for heavy duty is of 600 amperes capacity and this is the smallest switch that should be used in large power plants.

The outlines on the pages of dimensions show the diameter of the base of the porcelain insulators. This dimension is of interest to engineers because it indicates the rugged insulator used with these switches to obtain maximum strength.

**Strength of Insulators**—The following table gives the tensile and cantilever strength of the different insulators used on these switches, measured at a point  $2\frac{1}{2}$  inches above the cap.

Volts	Size of Base in Inches	Tensile Strength In Lbs.	Cantilever Strength In Lbs.
7500	3x4	2000	1000
7500	4x5	3000	1500
15000	3x4	2000	800
15000	4x5	3000	1200
15000	4x6	3000	2000
25000	3x5	2000	800
25000	4x6	3000	1500
50000	4x7	3000	1000
73000	4x8	3000	1000

## Construction

**Bases**—The bases are of a form that gives maximum strength and lightness. The switches for 7500 volts or more have bases of angle iron, giving a very light and strong structure and one that is well adapted for front and rear-connected switches.

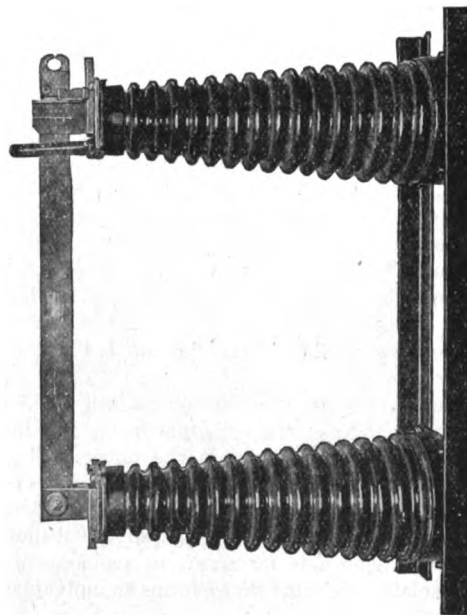
When pipe-mounting switches are required it is recommended that standard pipe-mounting brackets, two right-hand and two left-hand brackets, such as are used with switchboard panels be applied. These are listed in the section on Switchboard Details. The use of these brackets is more expensive than the use of J-bolts but assures rigid support of the switch on the pipe framework. Four standard J-bolts can be used to mount these switches on the pipe framework instead of the pipe-mounting brackets but these J-bolts are likely to straighten and to allow the switches to become loose.

The switches are intended for wall mounting, but they can be mounted in an inverted position because the locking device holds them tightly closed.

**Terminals**—Terminals are included for all switches up to and including the 800-ampere size. The jaw blocks of the 1200-ampere switches are designed for strap connection, while the jaw blocks of the 2000 and 3000-ampere switches are laminated and designed to take  $\frac{1}{4}$ -inch straight bus bar straps.

## Prices

In the tables of type S switches are listed the standard front-connected switches, standard rear-connected switches, and the forms of combined front and rear-connected switches which are most com-



TYPE S, 400-AMPERE, 73,000-VOLT, DISCONNECTING SWITCH—FRONT-CONNECTED

## DISCONNECTING SWITCHES—Continued

monly specified. Where required, other combinations can be furnished for all voltages up to and including 25,000 volts.

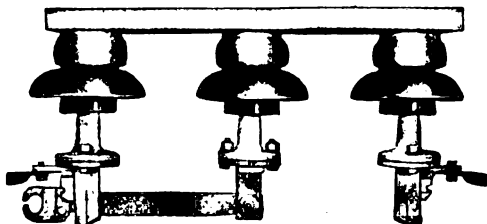
**Style number and list price** include the switch complete with or without marble base (for 2500-volt switches) or with angle iron base (for switches of higher voltages), terminal lugs, where used, and clamping nuts, but without operating stick. Unless previously obtained, at least one operating stick should be ordered with each order of disconnecting

switches. Standard operating sticks are listed in a table on a preceding page.

Where type S disconnecting switches are required without locks, orders should be entered to specify "Type S Disconnecting Switch with complete characteristics similar to Style No. . . . . except to have lock omitted." The omission price for locks is \$6.00 list per switch for single and double-throw switches, and \$12.00 list per switch for selector-type switches.

## TYPE R DISCONNECTING SWITCHES

**Insulators**—Insulator assemblies with galvanized hardware have been standardized in maximum ratings of 73,000 volts and in normal ratings from 88,000 to 154,000 volts. These assemblies are inter-



TYPE R SWITCH, 200 AMPERES, 7500 VOLTS MAXIMUM,  
DOUBLE-THROW

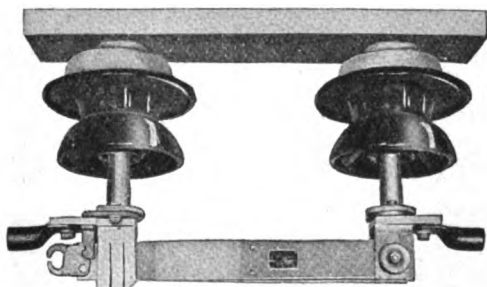
changeable with, and are the same as, those used on new expulsion fuses, redesigned choke coils, and other standardized outdoor equipment. Only three bolt circles have been used to cover this complete line. These are either two or four  $\frac{3}{8}$ -inch bolts on a  $2\frac{3}{8}$ -inch circle, four  $\frac{1}{2}$ -inch bolts on a 3-inch circle or four  $\frac{5}{8}$ -inch bolts on a 5-inch circle. These three sizes extend up to and including 37,000 volts, 110,000 volts and 154,000 volts, respectively. Switches with either underhung or inclined insulators all use identical insulator assemblies for a given rating.

This complete line of insulators has sanded heads

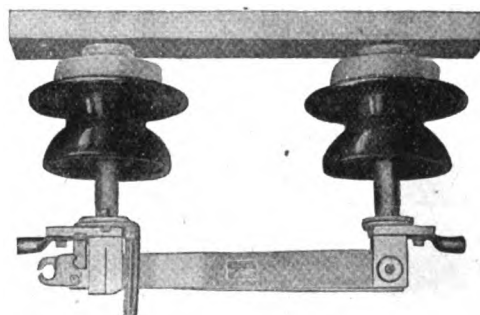
and pin holes which adhere firmly to the cement. All hardware is provided with cupped and ribbed holding surfaces from which the cement cannot slip. The Portland cement which is used at both cap and pin is steam set so as to avoid injurious stresses due to temperature changes.

The 4500 and 7500-volt insulators are single-piece porcelain, the 15,000, 25,000 and 37,000-volt insulators are two-shell and the 50,000 and 73,000-volt are three-shell. All of these are maximum-rated and the next higher rating of the apparatus should be chosen where tests above standard A.I.E.E. requirements are desired. Insulators for 88,000 and 110,000-volt service consist of two sections, each having three shells of porcelain. The 132,000-volt posts are three shell; three sections and four sections of the same type are used for 154,000 volts. All of these multiple-section posts are normally rated and are subject to five per cent increase in rating.

**Bases**—Hot-dip galvanized, channel-iron bases of standard section are used on all type R switches. Up to 73,000 volts inclusive, the bases are arranged for either flat or  $\frac{1}{4}$ -inch pipe mounting. U-bolts for pipe mounting are not furnished except when ordered. Bases on switches up to 15,000 volts inclusive have one set of holes at each end, and those above this size are supplied with two sets of

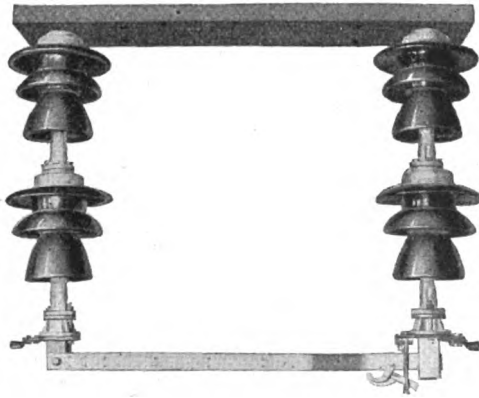


TYPE R SWITCH, 600 AMPERES, 37,000 VOLTS MAXIMUM,  
SINGLE-POLE, SINGLE-THROW



TYPE R SWITCH, 400 AMPERES, 37,000 VOLTS MAXIMUM,  
SINGLE-POLE, SINGLE-THROW

DISCONNECTING SWITCHES—Continued



TYPE R SWITCH, 400 AMPERES, 110,000 VOLTS NORMAL, SINGLE-POLE, SINGLE-THROW

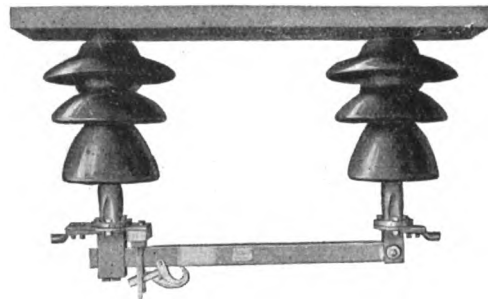
holes at each end. Each set consists of two  $\frac{9}{16}$ -inch holes at  $2\frac{3}{16}$ -inch centers, so arranged that the base may be mounted on two  $1\frac{1}{4}$ -inch pipes which are at right angles to it.

**Capacities**—Standard hook-stick-operated switches are listed for underhung and vertical wall mounting, that is, 45 degree mounting—the former up to 110,000 volts and the latter up to 37,000 volts, inclusive. Inverted-type switches can be obtained for upright mounting if desired as the bolt circles on the cap and pin of standardized insulators are the same. Switches for vertical mounting have the insulator axis at 45 degrees to the base. Insulators

on these switches are raised high enough above the base so that the dielectric field is not appreciably distorted.

Style number and list price include the switch complete with lock channel iron base; terminal lugs wherever used; clamping nuts; but without operating stick. Unless previously obtained, at least one operating stick should be ordered with each order of disconnecting switches. Standard operating sticks are listed on a following page.

Where type R disconnecting switches are required without locks, orders should be entered to specify "Type R disconnecting switch (with complete characteristics) similar to Style No. . . . . except to have lock omitted." The omission price per lock is \$6.00 list per switch for single and double-throw switches, and \$12.00 list per switch for selector-type switches



TYPE R SWITCH, 400 AMPERES, 73,000 VOLTS MAXIMUM SINGLE-POLE, SINGLE-THROW

PRICES

TYPE M INDOOR DISCONNECTING SWITCHES

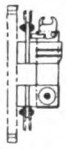
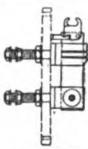
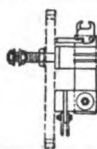
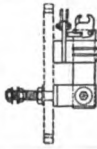
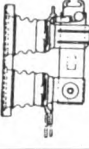
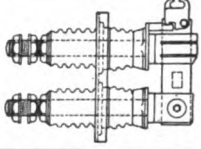
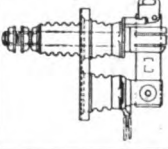
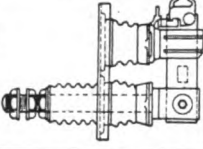
Single Throw, Upright, Wall-Mounting

Max. Volts	Max. Amperes	APPROX. WT., LBS.		Style Number	List Price
		Net	Shipping		
7500	100	14	18	50382	\$15 00
7500	300	18	25	173295	19 00
15000	100	18	23	50383	20 00
15000	300	23	30	173296	25 00

DISCONNECTING SWITCHES—Continued

TYPE S INDOOR DISCONNECTING SWITCHES

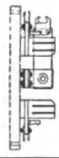
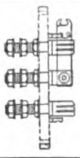
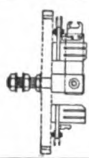
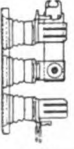
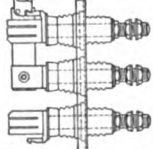
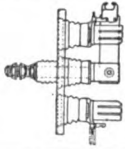
Single-throw

Max. Amps. Rating *30°	All Studs Front-Connected			All Studs Rear-Connected			One Stud Front, One Stud Rear-Connected			
	Approx. Lbs. Wt. †Net	Style No.	List Price	Approx. Lbs. Wt. †Net	Style No.	List Price	Approx. Lbs. Wt. †Net	Style Nos. Hinge Front Break Rear Hinge Rear		List Price
										
<b>PLAIN DUTY</b>										
<b>2500 Volts Maximum—Without Bases</b>										
200	2	304540	\$13 50	2½	304547	\$15 50	2¼	304553	304559	\$14 50
400	5	304541	18 50	7	304548	18 50	6	304554	304560	17 50
600	11	304542	26 50	15	304549	29 00	13	304555	304561	27 75
800	21	304543	38 00	25	304550	42 00	23	304556	304562	39 00
1200	30	304544	58 00	34	304551	67 00	32	304557	304563	62 00
2000	60	304545	115 00	66	304552	125 00	63	304558	304564	120 00
3000	140	304546	154 00							
<b>2500 Volts Maximum—With Bases</b>										
200	17	304565	26 50	19	304572	28 50	18	304578	304584	27 50
400	32	304566	29 50	34	304573	31 50	33	304579	304585	30 50
600	40	304567	39 50	44	304574	42 00	42	304580	304586	40 75
800	55	304568	52 00	65	304575	57 00	60	304581	304587	55 00
1200	70	304569	77 00	80	304576	85 00	75	304582	304588	81 00
2000	90	304570	135 00	104	304577	150 00	97	304583	304589	143 00
3000	185	304571	181 00							
										
<b>7500 Volts Maximum—With Bases</b>										
200	35	304590	34 00	41	304596	48 00	38	304602	304608	41 00
400	40	304591	38 00	46	304597	52 00	43	304603	304609	45 00
600	50	304592	52 00	58	304598	74 00	54	304604	304610	63 00
800	58	304593	67 00	68	304599	97 00	63	304605	304611	82 00
1200	78	304594	91 00	88	304600	132 00	83	304606	304612	112 00
2000	105	304595	155 00	119	304601	246 00	112	304607	304613	201 00
<b>15,000 Volts Maximum—With Bases</b>										
200	40	304614	41 00	46	304621	54 00	43	304627	304633	47 50
400	45	304615	45 00	53	304622	59 00	49	304628	304634	52 00
600	55	304616	59 00	65	304623	84 00	60	304629	304635	72 00
800	64	304617	73 00	74	304624	116 00	69	304630	304636	95 00
1200	90	304618	98 00	102	304625	143 00	96	304631	304637	121 00
2000	120	304619	167 00	134	304626	257 00	127	304632	304638	212 00
3000	160	304620	300 00							
<b>25,000 Volts Maximum—With Bases</b>										
200	60	304639	50 00	...	...	...	...	...	...	...
400	65	304640	54 00	...	...	...	...	...	...	...
600	70	304641	68 00	98	304665	113 00	84	304667	304669	91 00
800	80	304642	85 00	110	304666	137 00	95	304668	304670	111 00
1200	100	304643	120 00	130	304644	175 00	115	304645	304646	148 00
2000	130	312359	175 00	160	312360	260 00	145	312361	312362	228 00
<b>50,000 Volts Maximum—With Bases</b>										
400	85	304647	108 00	...	...	...	...	...	...	...
600	92	304648	136 00	...	...	...	...	...	...	...
<b>73,000 Volts Maximum—With Bases</b>										
400	130	304650	143 00	...	...	...	...	...	...	...
600	140	312363	170 00	...	...	...	...	...	...	...
<b>HEAVY DUTY</b>										
<b>7500 Volts Maximum—With Bases</b>										
600	52	304651	67 00	60	304653	98 00	56	304655	304657	83 00
800	60	304652	82 00	70	304654	121 00	65	304656	304658	100 00
<b>15,000 Volts Maximum—With Bases</b>										
600	62	304659	74 00	70	312347	108 00	66	312351	312355	95 00
800	70	304660	88 00	80	312348	140 00	75	312352	312356	112 00
1200	100	304661	113 00	112	312349	167 00	106	312353	312357	135 00
2000	132	304662	182 00	146	312350	281 00	139	312354	312358	222 00
<b>25,000 Volts Maximum—With Bases</b>										
600	85	304663	83 00	...	...	...	...	...	...	...
800	95	304664	100 00	...	...	...	...	...	...	...

\*The 20° ratings are the same as the 30° ratings except on the 2000 and 3000-ampere sizes, which are reduced to 1600 and 2400 amperes, respectively, for the 20° rating. It is recommended that, where switches are opened only seldom, the disconnecting switches be purchased on the 20° rating. See also a preceding page on "Temperature."  
 †For shipping weight add 50% to net weight.

DISCONNECTING SWITCHES—Continued

Double-Throw

Max. Amps. Rating *30°	All Studs Front-Connected			All Studs Rear-Connected			Break Studs Front-Connected Hinge Studs Rear-Connected		
	Approx. Lbs. Wt. †Net	Style No.	List Price	Approx. Lbs. Wt. †Net	Style No.	List Price	Approx. Lbs. Wt. †Net	Style No.	List Price
									
<b>PLAIN DUTY</b>									
<b>2500 Volts Maximum—Without Bases</b>									
200	3	321177	\$18 20	4	321184	\$21 00	3½	321190	\$19 25
400	7	321178	22 25	10	321185	25 00	8	321191	23 25
600	15	321179	35 50	21	321186	39 00	17	321192	36 75
800	29	321180	48 50	35	321187	57 00	31	321193	51 00
1200	42	321181	77 00	48	321188	91 00	44	321194	82 00
2000	84	321182	155 00	92	321189	172 00	87	321195	160 00
3000	196	321183	222 00	...	...	...	...	...	...
<b>2500 Volts Maximum—With Bases</b>									
200	24	321196	35 50	27	321203	38 50	25	321209	36 50
400	45	321197	40 00	48	321204	42 50	46	321210	41 00
600	56	321198	53 50	62	328205	51 00	58	321211	55 00
800	77	321199	70 00	91	321206	76 00	82	321212	72 00
1200	98	321200	104 00	112	321207	120 00	103	321213	109 00
2000	126	321201	181 00	146	321208	210 00	133	321214	191 00
3000	259	321202	250 00	...	...	...	...	...	...
									
<b>7500 Volts Maximum—With Bases</b>									
200	49	321215	46 00	57	321221	65 00	52	321227	53 00
400	56	321216	51 00	64	321222	70 00	59	321228	58 00
600	70	321217	70 00	81	321223	100 00	74	321229	80 00
800	81	321218	90 00	95	321224	131 00	86	321230	104 00
1200	109	321219	123 00	123	321225	178 00	114	321231	152 00
2000	147	321220	210 00	167	321226	332 00	154	312367	251 00
<b>15,000 Volts Maximum—With Bases</b>									
200	56	321233	55 00	64	321240	73 00	59	321246	61 00
400	63	321234	61 00	74	321241	80 00	67	321247	68 00
600	77	321235	80 00	81	321242	113 00	82	321248	91 00
800	90	321236	99 00	104	321243	157 00	95	321249	119 00
1200	126	321237	132 00	145	321244	193 00	132	321250	153 00
2000	156	321238	225 00	188	321245	347 00	167	312371	266 00
3000	224	321239	405 00	...	...	...	...	...	...
<b>25,000 Volts Maximum—With Bases</b>									
200	84	321252	68 00	...	...	...	...	...	...
400	91	321253	73 00	...	...	...	...	...	...
600	98	321254	92 00	137	321258	153 00	111	321262	113 00
800	112	321255	115 00	154	321259	185 00	126	321263	139 00
1200	140	321256	162 00	182	321260	237 00	154	321264	187 00
2000	182	321257	236 00	224	321261	350 00	200	312375	300 00
<b>50,000 Volts Maximum—With Bases</b>									
400	119	321266	146 00	...	...	...	...	...	...
600	129	321267	183 00	...	...	...	...	...	...
<b>73,000 Volts Maximum—With Bases</b>									
400	182	321268	208 00	...	...	...	...	...	...
600	196	321269	247 00	...	...	...	...	...	...
<b>HEAVY DUTY</b>									
<b>7500 Volts Maximum—With Bases</b>									
600	73	321270	89 00	84	321272	132 00	...	321274	104 00
800	84	321271	120 00	98	321273	165 00	...	321275	135 00
<b>15,000 Volts Maximum—With Bases</b>									
600	87	321276	100 00	98	321280	155 00	...	321284	129 00
800	98	321277	116 00	112	321281	186 00	...	321285	140 00
1200	140	321278	147 00	157	321282	217 00	...	321286	170 00
2000	185	321279	239 00	204	321283	352 00	...	321287	277 00
<b>25,000 Volts Maximum—With Bases</b>									
600	119	321288	101 00	...	...	...	...	...	...
800	133	321289	118 00	...	...	...	...	...	...

\*The 20° ratings are the same as the 30° ratings except on the 2000 and 3000-ampere sizes, which are reduced to 1600 and 2400 amperes, respectively, for the 20° rating. It is recommended that, where switches are opened only seldom, the disconnecting switches be purchased on the 20° rating. See also a preceding page on "Temperature."

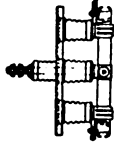
†For shipping weight add 50% to net weight.

Note:—As the 2000 and 3000-ampere switches have two blades, each rated at one-half the rating of the switch, the double-throw switches of these capacities may also be used as selector switches.



DISCONNECTING SWITCHES—Continued

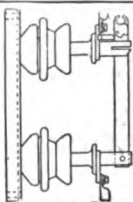
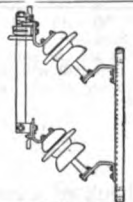
Double-throw, Selector-Type

Max. Amps. Rating *30°	Break Studs Front-Connected Hinge Studs Rear-Connected		
	Approximate Pounds, Weight †Net	Style No.	List Price
			
<b>PLAIN DUTY</b>			
<b>7500 Volts Maximum With Bases</b>			
400	65	312364	\$ 82 00
800	95	312365	153 00
1200	115	312366	209 00
2000	154	312367	251 00
<b>15,000 Volts Maximum With Bases</b>			
400	70	312368	99 00
800	105	312369	175 00
1200	140	312370	226 00
2000	167	312371	266 00
<b>25,000 Volts Maximum With Bases</b>			
400	90	312372	125 00
800	130	312373	206 00
1200	160	312374	277 00
2000	200	312375	300 00

\*The 20° ratings are the same as the 30° ratings, except on the 2000 and 3000-ampere sizes, which are reduced to 1600 and 2400 amperes, respectively, for the 20° rating. It is recommended that, where switches are opened only seldom, the disconnecting switches be purchased on the 20° rating. See also a preceding page on "Temperature."  
 †For shipping weight add 50% to net weight.

TYPES R AND RA OUTDOOR DISCONNECTING SWITCHES

Single-Pole With Locks

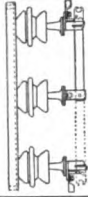
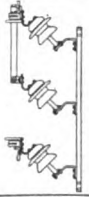
Volts†	Max. Amps.	Type R Inverted Mounting			Type RA 45° Mounting			
		Approx. Wt., Lbs. Net‡	Style No.	List Price	Approx. Wt., Lbs. Net‡	Style No.	List Price	
SINGLE THROW								
Outdoor	Indoor	Rating *30°						
4500	7500	200	15	370740	\$28 00	15	370788	\$32 00
		400	20	370741	31 50	20	370789	35 50
7500	15000	200	20	370742	31 50	20	370790	35 50
		400	25	370743	35 00	25	370791	39 00
		600	30	370744	48 00	30	370792	54 00
15000	25000	200	30	370745	37 00	30	370793	45 00
		400	35	370746	41 00	35	370794	49 00
		600	40	370747	57 00	40	370795	65 00
		1200	50	370748	78 00	60	370796	86 00
		2000	90	370749	111 00	90	370797	120 00
25000	35000	200	40	370750	46 00	40	370798	54 00
		400	45	370751	52 00	45	370799	60 00
		600	50	370752	69 00	50	370800	74 00
		1200	70	370753	96 00	70	370801	102 00
37000	45000	200	60	370754	61 00	60	370802	71 00
		400	70	370755	67 00	70	370803	77 00
		600	80	370756	83 00	80	370804	95 00
		1200	100	370757	120 00	100	370805	135 00
50000	60000	400	120	370758	85 00			
		600	130	370759	100 00			
73000	73000	400	150	370760	122 00			
		600	160	370761	148 00			
88000	110000	400	300	370762	155 00			
110000	132000	400	500	370763	246 00			

†Ratings of 73,000 volts and below are maximum; ratings above 73,000 volts are normal ratings and may safely be used at 5% above these values.

\*The 20° ratings are the same as the 30° ratings except that the 2000-ampere sizes are reduced to 1600 amperes for the 20° rating. It is recommended, where switches are seldom opened, that they be purchased on the 20° rating.

‡To obtain shipping weight, add 50% to net weight.

DISCONNECTING SWITCHES—Continued

Volts†		Max. Amps.	Type R Inverted Mounting			Type RA 45° Mounting		
Outdoor	Indoor	Rating *30°	Approx. Wt., Lbs. Net‡	Style No.	List Price	Approx. Wt., Lbs. Net‡	Style No.	List Price
DOUBLE THROW								
								
4500	7500	200 400	22 30	370764 370765	\$42 00 47 00	22 30	370806 370807	\$48 00 53 00
7500	9000	200 400 600	30 37 45	370766 370767 370768	47 00 52 00 70 00	30 37 45	370808 370809 370810	53 00 58 00 80 00
15000	22000	200 400 600 1200 2000	45 52 60 90 135	370769 370770 370771 370772 370773	55 00 61 00 82 00 117 00 166 00	45 52 60 90 135	370811 370812 370813 370814 370815	67 00 73 00 94 00 130 00 175 00
25000	37000	200 400 600 1200	60 67 75 105	370774 370775 370776 370777	69 00 78 00 100 00 144 00	60 67 73 105	370816 370817 370818 370819	81 00 90 00 112 00 150 00
37000	44000	..... ..... ..... .....	90 105 120 150	370778 370779 370780 370781	91 00 100 00 124 00 180 00	90 103 120 150	370820 370821 370822 370823	105 00 115 00 142 00 200 00
50000	66000	..... .....	180 195	370782 370783	122 00 150 00	..... .....	..... .....	..... .....
73000	73000	..... .....	225 240	370784 370785	183 00 222 00	..... .....	..... .....	..... .....
88000	88000	.....	450	370786	232 00	.....	.....	.....
110000	110000	.....	750	370787	369 00	.....	.....	.....
SELECTOR TYPE								
4500	7500	400	.....	370834	\$54 00	.....	370840	\$62 00
7500	15000	400 800	..... .....	370835 370836	64 00 70 00	..... .....	370841 370842	69 00 80 00
15000	22000	400 800 1200 2000	..... ..... ..... .....	370837 370838 370839 370773	79 00 110 00 150 00 210 00	..... ..... ..... .....	370843 370844 370845 370815	95 00 105 00 170 00 230 00

†Ratings of 73,000 volts and below are maximum; ratings above 73,000 volts are normal ratings and may safely be used at 5% above these values.  
 \*The 20° ratings are the same as the 30° ratings except that the 2000-ampere sizes are reduced to 1600 amperes for the 20° rating. It is recommended, where switches are seldom opened, that they be purchased on the 20° rating.  
 ‡To obtain shipping weight, add 50% to net weight.

HOOK STICKS

The type R hook stick consists of a wooden rod so treated as to form an effective insulator to ground and a double hook at one end properly designed to engage in the blade holes and latches of various types of switches. These sticks may be used with either the type S or the type R disconnecting switches. Indoor and outdoor sticks 10 feet long, and longer, have a 2-foot Micarta rod under the hook. Indoor sticks 16 feet long, and longer, and

all outdoor sticks, are supplied with a grounding clamp and chain. Sticks 16 feet long, and longer, are in two detachable sections. The larger outdoor sticks are also supplied with treated wooden shields, which along with the Micarta rod and grounding chain, form an effective protective medium.

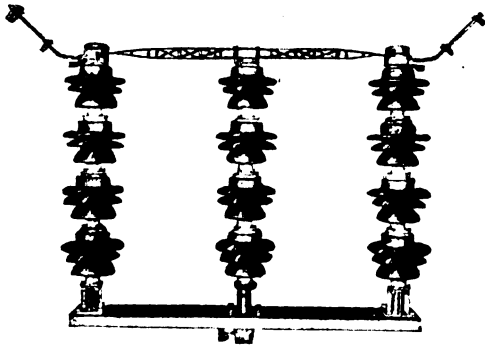
Style numbers and list prices include a hook stick complete with hook and auxiliaries as specified above.

PRICES

FOR INDOOR USE					FOR OUTDOOR USE					
Length in Ft.	Net Wt. in Lbs.	Shipping Wt.	Style No.	List Price	Lgth. in Ft.	No. of Shields	Net Wt. in Lbs.	Ship. Wt., Lbs.	Style No.	List Price
2½	1½	2½	364227	\$3 50	4	0	4	8	364232	\$5 50
6	6	12	364228	6 50	8	1	9	18	364233	10 50
10	10	20	364229	10 50	12	2	14	28	364234	16 50
16	16	32	364230	16 50	18	3	22	44	364235	24 50
20	20	40	364231	20 50	24	4	30	60	364236	30 50

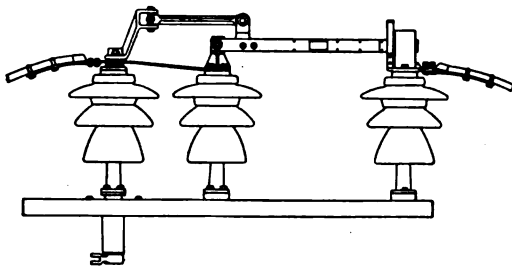
DISCONNECTING SWITCHES—Continued

TYPE R REMOTE CONTROL DISCONNECTING SWITCHES



TYPE R REMOTE CONTROL SWITCH, 400 AMPERES, 154,000 VOLTS, 3-POLE, SINGLE-THROW

The type R three-pole, remote-control outdoor disconnecting switches are designed for mounting upright with all porcelain in compression. The three poles are operated simultaneously, being provided for inter-connection with iron pipe, which is to be furnished by the user. The pull is directed downward by bell cranks to the hand mechanism which is supplied with a detachable wood handle.



TYPE R OUTDOOR REMOTE CONTROL SWITCH, 600 AMPERES, 66,000 VOLTS, 3-POLE, SINGLE-THROW

All switches above 73,000 volts use insulation of the separable-unit type. The required mechanical strength makes it necessary to use this form of insulation. Insulators of this type are necessarily

heavier and are mounted upright on type R switches because commercial porcelain has a compressive strength of 20,000 pounds per square inch as compared with 1200 pounds in tension. All of these insulators are provided with extra large pin holes and sanded holding surfaces on the porcelain. The hardware has ribbed holding surfaces. Portland cement is used in assembling and is steam set to relieve internal stresses due to temperature changes.

Construction

All parts on which heavy stresses are imposed are of cast steel. Malleable iron is used, where advisable, to overcome possible breakage of parts while in service. The contacts are of the self-aligning



SPRING BUMPER ASSEMBLED FOR OPERATING MECHANISM ON 73,000-VOLT SWITCH

rocker type and have ample contact surface for outdoor conditions. Contacts are well protected with galvanized steel hoods.

The blades are of a trussed construction and guides are furnished at the break jaws to prevent possibility of injury to contacts. The blade forms an integral part of the rotating post. The bushings are of an

improved bearing metal. Lead supports are furnished with both break jaws and all terminals have two bolt holes.

These switches can be supplied with a motor-operated mechanism when desired. Prices furnished on request.

TYPES RV AND RH DISCONNECTING SWITCHES

The 400 and 600-ampere, 73,000 volts maximum, three-pole, remote-control disconnecting switches are of the vertical-break, knuckle-joint type and are not supplied with arcing horns. The operating mechanism is supplied with a spring bumper to prevent the blade from slamming.

At the higher voltages the double-horizontal form of break is used. No spring bumper is required with this type of switch.

Current-Carrying Parts—The blades are extra

heavy, truss construction. The contacts are of the flexible finger, self-aligning type with ample contact surface.

Operating Mechanism—The operating mechanism is supplied with a detachable wood handle and a pin for locking in the open and closed positions.

Style numbers and list prices include switch, complete with or without horns, with operating handle and bell cranks, but without a connecting rod between bell cranks.

Volts,† Indoor and Outdoor	Max. Rating, Amperes 20° and 30°	WITHOUT ARCING HORNS				WITH ARCING HORNS			
		APPROX. Net	WT., LBS. Gross	Style No.	List Price	APPROX. Net	WT., LBS. Gross	Style No.	List Price
<b>Three-pole, Remote-Control</b>									
<b>Type RV Knuckle Joint Type, Single Vertical Break</b>									
73000	400	1000	1500	370846	\$ 800 00	...	...	.....	.....
	600	1200	1800	370847	1000 00	...	...	.....	.....
<b>Type RH Double Horizontal Break</b>									
88000	400	2000	3000	370848	1200 00	2100	3100	370852	\$1400 00
110000	400	3000	4500	370849	1600 00	3100	4600	370853	1800 00
132000	400	4000	6000	370850	2300 00	4100	6100	370854	2500 00
154000	400	5000	7500	370851	2600 00	5100	7600	370855	2800 00

†73,000 volts is maximum. 88,000 volts and above are normal ratings and may safely be used at 5% over these values.

DISCONNECTING SWITCHES—Continued

\*OUTLINE DIMENSIONS

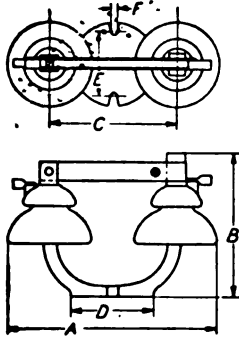


FIG. 1—TYPE M, 300-AMPERES, 15,000 VOLTS

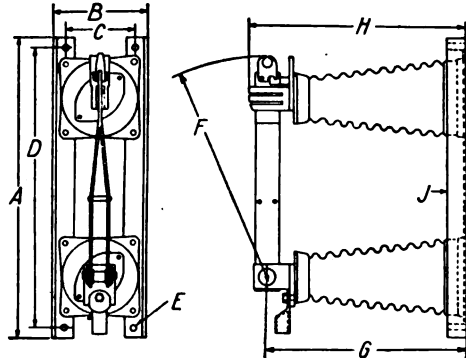


FIG. 2—TYPE S, 400 AMPERES, 25,000 VOLTS

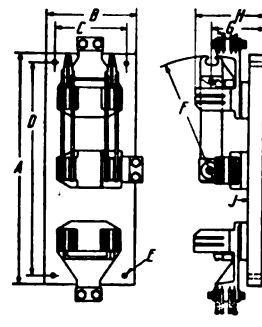


FIG. 3—TYPE S, 3000 AMPERES, 2500 VOLTS

TYPE M DISCONNECTING SWITCHES

Amps.	Volts	Fig. No.	Style No.	DIMENSIONS IN INCHES					
				A	B	C	D	E	F
100	7500	1	50382	12½	9¾	9	6	4½	1½
300	7500	1	173295	15	10¾	9	6	4½	1½
100	15000	1	50383	15	10¾	9	6	4½	1½
300	15000	1	173296	15	11	9	6	4½	1½

TYPE S DISCONNECTING SWITCHES

Amps.	Volts	Figure No.	Style No.	Post Ina. Diam.	DIMENSIONS IN INCHES									
					A	B	C	D	E	F	G	H	J	
					SINGLE-THROW, FRONT-CONNECTED									
<b>Standard Duty</b>														
200	7500	2	304590	3x4 15¼	6	4½	13¾	¾	9¾	7¾	9¼	9¼	1¼	1¼
400	7500	2	304591	3x4 15¼	6	4½	13¾	¾	10¼	8¼	9¾	9¾	1¼	1¼
600	7500	2	304592	3x4 15¼	6	4½	13¾	¾	10¾	8¼	10	10	1¼	1¼
800	7500	2	304593	3x4 15¼	6	4½	13¾	¾	11¼	8¼	10¼	10¼	1¼	1¼
1200	7500	2	304594	4x5 17¼	7	5½	15¼	¾	13¾	10¾	12¾	12¾	1¼	1¼
2000	7500	2	304595	4x5 17¼	7	5½	15¼	¾	13¾	9¾	11¾	11¾	1¼	1¼
200	15000	2	304814	3x4 17¼	6	4½	15¼	¾	11¾	9¾	11¾	11¾	1¼	1¼
400	15000	2	304815	3x4 17¼	6	4½	15¼	¾	12¼	10¼	11¾	11¾	1¼	1¼
600	15000	2	304816	3x4 17¼	6	4½	15¼	¾	12¾	10¼	12	12	1¼	1¼
800	15000	2	304817	3x4 17¼	6	4½	15¼	¾	13¼	10¾	12¼	12¼	1¼	1¼
1200	15000	2	304818	4x5 19¼	7	5½	17¾	¾	15¼	12¾	14¾	14¾	1¼	1¼
2000	15000	2	304819	4x5 19¼	7	5½	17¾	¾	15¾	11¾	13¾	13¾	1¼	1¼
3000	15000	2	304820	4x6 20¾	8	6	19	¾	15¾	12¾	14¾	14¾	1¼	1¼
200	25000	2	304839	3x5 22	7¾	5½	20¼	¾	15¾	12¾	14¾	14¾	2	2
400	25000	2	304840	3x5 22	7¾	5½	20¼	¾	15¾	13¼	14¾	14¾	2	2
600	25000	2	304841	3x5 22	7¾	5½	20¼	¾	16¼	13¼	15	15	2	2
800	25000	2	304842	3x5 22	7¾	5½	20¼	¾	16¾	13¼	15¼	15¼	2	2
1200	25000	2	304843	4x6 23¼	8¼	6	21¼	¾	18¾	15¾	17¾	17¾	2	2
2000	25000	2	312359	4x6 23¼	8¼	6	21¼	¾	17¾	14¼	16¾	16¾	2	2
400	50000	2	304847	4x7 30¼	9	6¾	28¼	¾	22¼	20¼	23¾	23¾	2	2
600	50000	2	304848	4x7 30¼	9	6¾	28¼	¾	22¼	20¾	23¾	23¾	2	2
400	73000	2	304850	4x8 39¼	9¾	7½	37¼	¾	30¼	27¾	30¾	30¾	2	2
600	73000	2	312363	4x8 39¼	9¾	7½	37¼	¾	30¾	27¾	30¾	30¾	2	2
<b>Heavy Duty</b>														
600	7500	2	304851	4x5 17¼	7	5½	15¼	¾	11¾	9¾	10¾	10¾	1¼	1¼
800	7500	2	304852	4x5 17¼	7	5½	15¼	¾	12¼	9¾	11¾	11¾	1¼	1¼
600	15000	2	304859	4x6 20¼	8	6	19	¾	13¾	11¾	12¾	12¾	1¼	1¼
800	15000	2	304860	4x6 20¼	8	6	19	¾	14¼	11¾	13¼	13¼	1¼	1¼
1200	15000	2	304861	4x6 20¼	8	6	19	¾	15¼	12¾	14¾	14¾	1¼	1¼
2000	15000	2	304862	4x6 20¼	8	6	19	¾	15¾	11¾	13¾	13¾	1¼	1¼
600	25000	2	304863	4x6 23¼	8¼	6	21¼	¾	16¾	13¾	15¾	15¾	2	2
800	25000	2	304864	4x6 23¼	8¼	6	21¼	¾	16¾	13¾	15¾	15¾	2	2

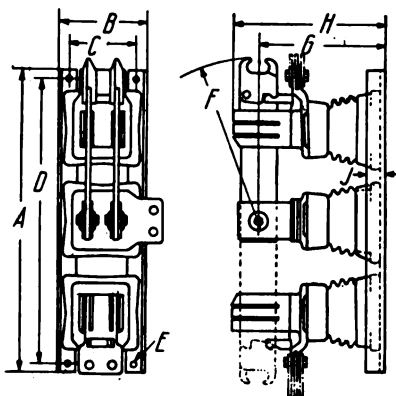


FIG. 4—TYPE S, 2000 AMPERES, 15,000 VOLTS

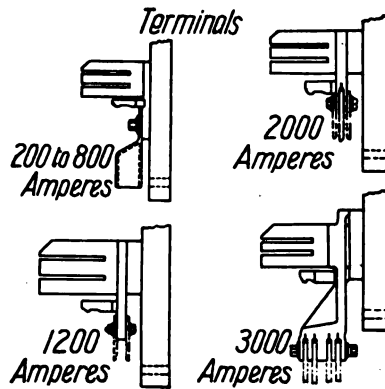


FIG. 5—TYPE S, BREAK-JAW DETAIL

\*See first footnote, page 105.

The dimensions are for reference only. For official dimensions apply to the nearest district office.



DISCONNECTING SWITCHES—Continued

\*OUTLINE DIMENSIONS—TYPE S DISCONNECTING SWITCHES—Continued

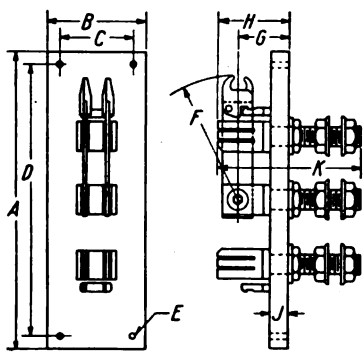


FIG. 8—TYPE S, 2000 AMPERES, 2500 VOLTS

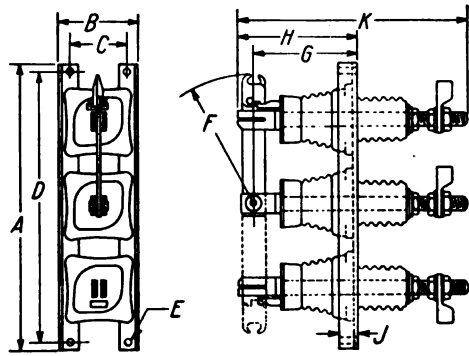


FIG. 9—TYPE S, 800 AMPERES, 15,000 VOLTS

DOUBLE-THROW, REAR-CONNECTED

Amps.	Volts	Figure No.	Style No.	Post Ins. Diam.	DIMENSIONS IN INCHES									
					A	B	C	D	E	F	G	H	J	K
					<b>Standard Duty</b>									
200	2500	8	321203	...	32	8	5 1/2	29 1/2	7/8	8 3/8	3 1/2	4 1/2	1 1/2	6 1/2
400	2500	8	321204	...	32	8	5 1/2	29 1/2	7/8	10 1/8	4	5 1/2	1 1/2	7 3/8
600	2500	8	321205	...	32	8	5 1/2	29 1/2	7/8	10 1/8	4 1/2	5 3/4	1 1/2	8 3/4
800	2500	8	321206	...	32	8	5 1/2	29 1/2	7/8	10 1/8	4 3/8	6 1/4	1 1/2	10
1200	2500	8	321207	...	32	10	7 1/2	29 1/2	7/8	13 3/4	5 1/2	8 3/8	2	13 7/8
2000	2500	8	321208	...	32	10	7 1/2	29 1/2	7/8	13 3/4	5 3/8	7 3/8	2	14 7/8
200	7500	9	321221	3x4	22 3/4	6	4 1/4	21 1/4	7/8	9 7/8	8 1/2	9 1/2	1 1/2	15
400	7500	9	321222	3x4	22 3/4	6	4 1/4	21 1/4	7/8	10 1/8	8 3/8	9 3/8	1 1/2	16 3/8
600	7500	9	321223	3x4	22 3/4	6	4 1/4	21 1/4	7/8	10 1/8	8 3/8	10 1/8	1 1/2	17
800	7500	9	321224	3x4	22 3/4	6	4 1/4	21 1/4	7/8	11 1/8	8 3/8	10 5/8	1 1/2	17 3/4
1200	7500	9	321225	4x5	24 3/4	7	5 1/2	23 1/4	7/8	13 3/8	10 3/8	12 5/8	1 1/2	21 1/2
2000	7500	9	321226	4x5	24 3/4	7	5 1/2	23 1/4	7/8	13 3/8	9 3/4	11 3/4	1 1/2	21 3/4
200	15000	9	321240	3x4	25 3/4	6	4 1/4	24 1/4	7/8	11 1/2	11 1/2	11 1/2	1 1/2	19
400	15000	9	321241	3x4	25 3/4	6	4 1/4	24 1/4	7/8	12 1/8	10 3/8	11 3/8	1 1/2	20 3/8
600	15000	9	321242	3x4	25 3/4	6	4 1/4	24 1/4	7/8	12 1/8	10 3/8	12 1/8	1 1/2	21
800	15000	9	321243	3x4	25 3/4	6	4 1/4	24 1/4	7/8	13 1/8	10 3/8	12 3/8	1 1/2	21 3/4
1200	15000	9	321244	4x5	28 3/4	7	5 1/2	27 1/4	7/8	15 1/8	12 3/8	14 3/8	1 1/2	25 3/4
2000	15000	9	321245	4x5	28 3/4	7	5 1/2	27 1/4	7/8	15 1/8	11 3/8	13 3/8	1 1/2	25 3/4
600	25000	9	321258	4x6	35 1/2	8 1/4	6	33 1/2	7/8	16 3/8	13 3/8	15 3/8	2	27 3/4
800	25000	9	321259	4x6	35 1/2	8 1/4	6	33 1/2	7/8	16 3/8	14 3/8	15 3/8	2	28 1/4
1200	25000	9	321260	4x6	35 1/2	8 1/4	6	33 1/2	7/8	18 3/8	14 3/8	17 3/8	2	31 1/4
2000	25000	9	321261	4x6	35 1/2	8 1/4	6	33 1/2	7/8	17 3/8	14 3/8	16 3/8	2	31 7/8
					<b>Heavy Duty</b>									
600	7500	9	321272	4x5	24 3/4	7	5 1/2	23 1/4	7/8	11 7/8	9 3/8	10 3/8	1 1/2	18
800	7500	9	321273	4x5	24 3/4	7	5 1/2	23 1/4	7/8	11 7/8	9 3/8	11 3/8	1 1/2	18 3/4
600	15000	9	321280	4x6	30	8	6	28 1/2	7/8	13 7/8	11 3/8	12 3/8	1 1/2	22
800	15000	9	321281	4x6	30	8	6	28 1/2	7/8	14 3/8	11 3/8	13 3/8	1 1/2	22 3/4
1200	15000	9	321282	4x6	30	8	6	28 1/2	7/8	15 7/8	12 3/8	14 3/8	1 1/2	25 1/4
2000	15000	9	321283	4x6	30	8	6	28 1/2	7/8	15 7/8	11 3/8	13 3/8	1 1/2	25 3/4

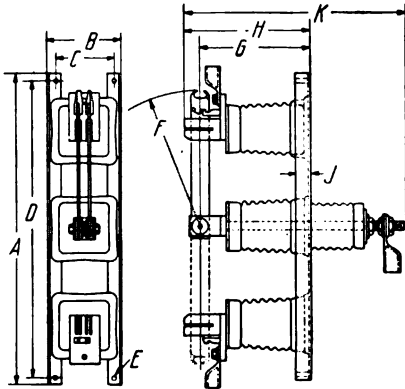


FIG. 10—TYPE S SELECTOR, 800 AMPERES, 15,000 VOLTS

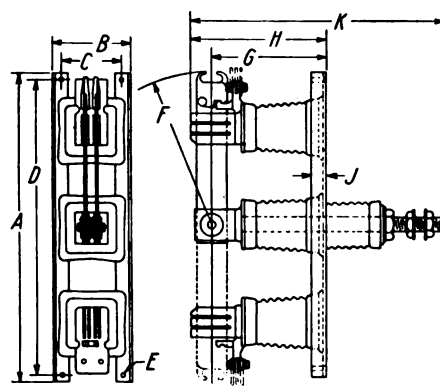


FIG. 11—TYPE S SELECTOR, 2000 AMPERES, 25,000 VOLTS

SELECTOR

Amps.	Volts	Figure No.	Style No.	Post Ins. Diam.	DIMENSIONS IN INCHES									
					A	B	C	D	E	F	G	H	J	K
400	7500	10	312364	3x4	24 3/4	7	5 1/4	23 1/4	7/8	10 7/8	8 5/8	9 3/4	1 1/2	16 3/4
800	7500	10	312365	3x4	24 3/4	7	5 1/4	23 1/4	7/8	11 1/8	9	10 3/8	1 1/2	18 1/8
1200	7500	10	312366	4x5	24 3/4	7	5 1/4	23 1/4	7/8	11 7/8	9 7/8	10 3/8	1 1/2	19 1/2
2000	7500	11	312367	4x5	24 3/4	7	5 1/4	23 1/4	7/8	13 3/8	9 3/4	11 3/8	1 1/2	20 1/2
400	15000	10	312368	3x4	28 3/4	7	5 1/4	27 1/4	7/8	12 7/8	10 5/8	11 3/8	1 1/2	21 3/4
800	15000	10	312369	3x4	28 3/4	7	5 1/4	27 1/4	7/8	13 1/8	11	12 3/8	1 1/2	22 3/4
1200	15000	10	312370	4x5	28 3/4	7	5 1/4	27 1/4	7/8	13 7/8	11 7/8	12 3/8	1 1/2	23 3/4
2000	15000	11	312371	4x5	28 3/4	7	5 1/4	27 1/4	7/8	15 3/8	11 3/8	13 3/8	1 1/2	25 3/4
400	25000	10	312372	4x6	35 1/2	8 1/4	6	33 1/2	7/8	16 3/8	14 3/8	15 3/8	2	27 3/4
800	25000	10	312373	4x6	35 1/2	8 1/4	6	33 1/2	7/8	16 3/8	14 3/8	15 3/8	2	29 1/4
1200	25000	10	312374	4x6	35 1/2	8 1/4	6	33 1/2	7/8	16 3/8	14 3/8	15 3/8	2	29 3/4
2000	25000	11	312375	4x6	35 1/2	8 1/4	6	33 1/2	7/8	17 7/8	14 3/8	16 3/8	2	31 1/2

\*See first footnote, page 105.

The dimensions are for reference only. For official dimensions apply to the nearest district office.

DISCONNECTING SWITCHES—Continued

\*OUTLINE DIMENSIONS—Continued

TYPE R DISCONNECTING SWITCHES

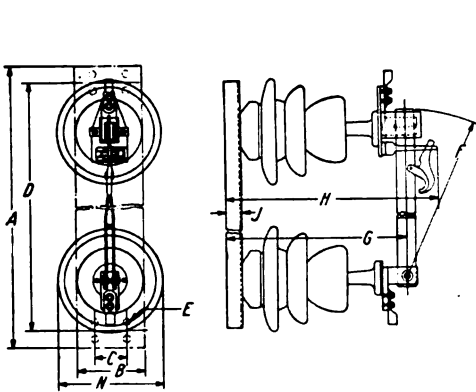


FIG. 12—TYPE R, 600 AMPERES, 73,000 VOLTS

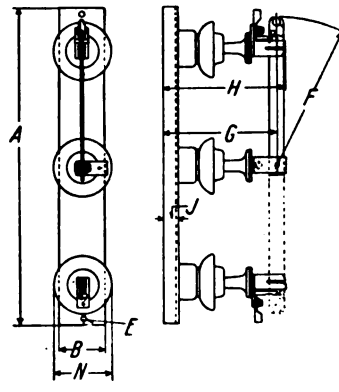


FIG. 13—TYPE R, 600 AMPERES, 15,000 VOLTS

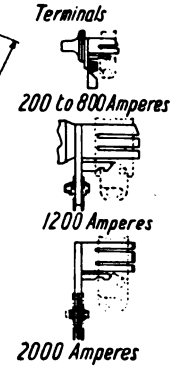


FIG. 14—TYPE R, BREAK-JAWS

SINGLE-THROW, FRONT-CONNECTED, INVERTED MOUNTING

Amps.	VOLTS		Figure No.	Style No.	DIMENSIONS IN INCHES										
	Outdoor	Indoor			†A	†B	†C	†D	†E	F	G	H	J	N	
200	4500	7500	12	370740	24	3	..	20	9 1/2	9 1/2	10 1/2	1 1/2	3 3/4		
400	4500	7500	12	370741	24	3	..	20	10 1/2	9 1/2	11 1/2	1 1/2	3 3/4		
200	7500	15000	12	370742	24	4	..	20	11 1/2	11 1/2	12 1/2	1 1/2	6		
400	7500	15000	12	370743	24	4	..	20	12 1/2	11 1/2	13 1/2	1 1/2	6		
600	7500	15000	12	370744	24	4	..	20	12 1/2	11 1/2	13 1/2	1 1/2	6		
200	15000	25000	12	370745	24	4	..	20	15 1/2	12 1/2	13 1/2	1 1/2	7		
400	15000	25000	12	370746	24	4	..	20	15 1/2	12 1/2	14 1/2	1 1/2	7		
600	15000	25000	12	370747	24	4	..	20	16 1/2	13 1/2	14 1/2	1 1/2	7		
1200	15000	25000	12	370748	24	4	..	20	18 1/2	14 1/2	16 1/2	1 1/2	7		
2000	15000	25000	12	370749	24	4	..	20	17 1/2	13 1/2	15 1/2	1 1/2	9		
200	25000	35000	12	370750	34	5	3	30	22 1/2	15 1/2	18 1/2	1 1/2	9		
400	25000	35000	12	370751	34	5	3	30	22 1/2	15 1/2	18 1/2	1 1/2	9		
600	25000	35000	12	370752	34	5	3	30	22 1/2	15 1/2	17 1/2	1 1/2	9		
1200	25000	35000	12	370753	34	5	3	30	24 1/2	16 1/2	18 1/2	1 1/2	9		
200	37000	45000	12	370754	34	5	3	30	22 1/2	16 1/2	20	1 1/2	10 1/2		
400	37000	45000	12	370755	34	5	3	30	22 1/2	16 1/2	20	1 1/2	10 1/2		
600	37000	45000	12	370756	34	5	3	30	22 1/2	17	18 1/2	1 1/2	10 1/2		
1200	37000	45000	12	370757	34	5	3	30	24 1/2	17 1/2	20 1/2	1 1/2	10 1/2		
400	50000	60000	12	370758	44	6	3	40	30 1/2	21 1/2	24 1/2	1 1/2	13		
600	50000	60000	12	370759	44	6	3	40	30 1/2	21 1/2	23 1/2	1 1/2	13		
400	73000	73000	12	370760	44	6	3	40	32 1/2	25 1/2	30 1/2	1 1/2	15		
600	73000	73000	12	370761	44	6	3	40	33 1/2	25 1/2	30 1/2	1 1/2	15		
400	88000	110000	17	370762	54	8	5	30	43 1/2	41 1/2	45 1/2	2 1/2	13 1/2		
400	110000	132000	17	370763	66	10	5	40	55 1/2	47 1/2	51 1/2	2 1/2	15		

DOUBLE-THROW, FRONT-CONNECTED, INVERTED MOUNTING

Amps.	VOLTS		Figure No.	Style No.	DIMENSIONS IN INCHES										
	Outdoor	Indoor			†A	†B	†C	†D	†E	F	G	H	J	N	
200	4500	7500	13	370764	34	3	..	30	9 1/2	9 1/2	10 1/2	1 1/2	3 3/4		
400	4500	7500	13	370765	34	3	..	30	10 1/2	9 1/2	11 1/2	1 1/2	3 3/4		
200	7500	15000	13	370766	34	4	..	30	11 1/2	11 1/2	12 1/2	1 1/2	6		
400	7500	15000	13	370767	34	4	..	30	12 1/2	11 1/2	13 1/2	1 1/2	6		
600	7500	15000	13	370768	34	4	..	30	12 1/2	11 1/2	13 1/2	1 1/2	6		
200	15000	25000	13	370769	40	4	..	36	15 1/2	12 1/2	13 1/2	1 1/2	7		
400	15000	25000	13	370770	40	4	..	36	15 1/2	13 1/2	14 1/2	1 1/2	7		
600	15000	25000	13	370771	40	4	..	36	16 1/2	13 1/2	14 1/2	1 1/2	7		
1200	15000	25000	13	370772	40	4	..	36	18 1/2	14 1/2	16 1/2	1 1/2	7		
2000	15000	25000	13	370773	40	4	..	36	17 1/2	13 1/2	15 1/2	1 1/2	7		
200	25000	35000	13	370774	48	5	3	26	22 1/2	15 1/2	18 1/2	1 1/2	9		
400	25000	35000	13	370775	48	5	3	26	22 1/2	15 1/2	18 1/2	1 1/2	9		
600	25000	35000	13	370776	48	5	3	26	22 1/2	15 1/2	17 1/2	1 1/2	9		
1200	25000	35000	13	370777	48	5	3	26	24 1/2	16 1/2	18 1/2	1 1/2	9		
200	37000	45000	13	370778	48	5	3	26	22 1/2	17 1/2	20	1 1/2	10 1/2		
400	37000	45000	13	370779	48	5	3	26	22 1/2	17 1/2	18 1/2	1 1/2	10 1/2		
600	37000	45000	13	370780	48	5	3	26	24 1/2	17 1/2	20 1/2	1 1/2	10 1/2		
1200	37000	45000	13	370781	48	5	3	26	24 1/2	17 1/2	20 1/2	1 1/2	10 1/2		
400	50000	60000	13	370782	64	6	3	40	30 1/2	22	24 1/2	1 1/2	13		
600	50000	60000	13	370783	64	6	3	40	30 1/2	22 1/2	23 1/2	1 1/2	13		
400	73000	73000	13	370784	74	6	3	50	32 1/2	25 1/2	30 1/2	2 1/2	15		
600	73000	73000	13	370785	74	6	3	50	33 1/2	25 1/2	30 1/2	2 1/2	15		
400	88000	110000	17	370786	96	8	5	70	43 1/2	41 1/2	45 1/2	2 1/2	13 1/2		
400	110000	132000	17	370787	120	10	5	80	55 1/2	47 1/2	51 1/2	2 1/2	15		

\*The outline drawings showing type S and type R disconnecting switches are intended to represent the general outlines of these switches. The drawings do not cover the details of all the ratings listed in the table but do apply in detail however, to the rating given as a caption. Taken as a group, these drawings show all features for the different ratings and classifications.

†For base and mounting bolt dimensions refer to Fig. 20, page 108.

The dimensions are for reference only. For official dimensions apply to the nearest district office.

DISCONNECTING SWITCHES—Continued

\*OUTLINE DIMENSIONS—Continued

TYPE R DISCONNECTING SWITCHES—Continued

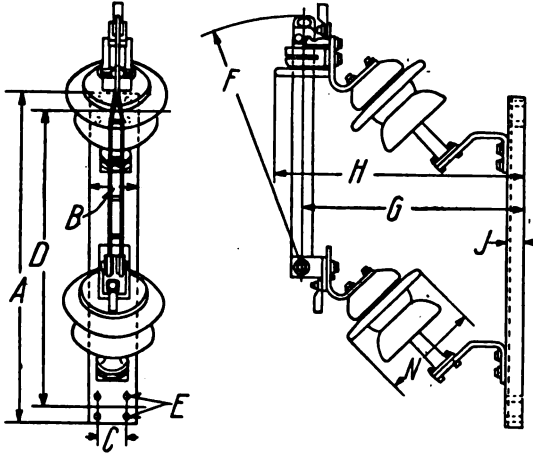


FIG. 15—TYPE R, 600 AMPERES, 37,000 VOLTS

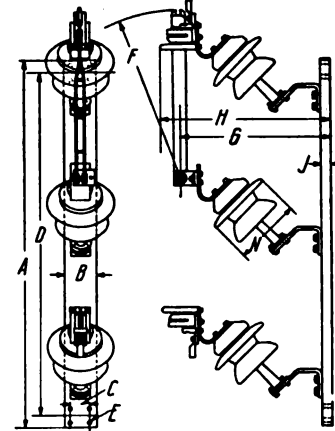


FIG. 16—TYPE R, 600 AMPERES, 37,000 VOLTS

SINGLE-THROW, FRONT-CONNECTED, 45-DEGREE MOUNTING

Amps.	VOLTS		Figure No.	Style No.	DIMENSIONS IN INCHES										
	Outdoor	Indoor			†A	†B	†C	†D	†E	F	G	H	J	N	
200	4500	7500	15	370788	24	3	..	20	13 1/2	13 1/2	13 1/2	14 1/2	1 1/2	3 3/4	
400	4500	7500	15	370789	24	3	..	20	13 1/2	13 1/2	14 1/2	14 1/2	1 1/2	3 3/4	
200	7500	15000	15	370790	28	4	..	24	17 1/2	14 1/2	15 1/2	15 1/2	1 1/2	6	
400	7500	15000	15	370791	28	4	..	24	17 1/2	14 1/2	15 1/2	16 1/2	1 1/2	6	
600	7500	15000	15	370792	28	4	..	24	18 1/2	15 1/2	16 1/2	16 1/2	1 1/2	6	
200	15000	25000	15	370793	30	4	..	26	19 1/2	17 1/2	18 1/2	18 1/2	1 1/2	7	
400	15000	25000	15	370794	30	4	..	26	19 1/2	17 1/2	19 1/2	19 1/2	1 1/2	7	
600	15000	25000	15	370795	30	4	..	26	20 1/2	17 1/2	19 1/2	19 1/2	1 1/2	7	
1200	15000	25000	15	370796	30	4	..	26	22 1/2	19 1/2	22 1/2	25 1/2	1 1/2	7	
2000	15000	25000	15	370797	30	4	..	26	21 1/2	19 1/2	21 1/2	25 1/2	1 1/2	7	
200	25000	35000	15	370798	40	5	3	36	26 1/2	22 1/2	25 1/2	25 1/2	1 1/2	9	
400	25000	35000	15	370799	40	5	3	36	26 1/2	22 1/2	25 1/2	25 1/2	1 1/2	9	
600	25000	35000	15	370800	40	5	3	36	26 1/2	22 1/2	24 1/2	24 1/2	1 1/2	9	
1200	25000	35000	15	370801	40	5	3	36	28 1/2	24 1/2	26 1/2	26 1/2	1 1/2	9	
200	37000	45000	15	370802	40	5	3	36	26 1/2	23 1/2	26 1/2	26 1/2	1 1/2	10 1/2	
400	37000	45000	15	370803	40	5	3	36	26 1/2	23 1/2	26 1/2	26 1/2	1 1/2	10 1/2	
600	37000	45000	15	370804	40	5	3	36	26 1/2	23 1/2	25 1/2	25 1/2	1 1/2	10 1/2	
1200	37000	45000	15	370805	40	5	3	36	28 1/2	25 1/2	27 1/2	27 1/2	1 1/2	10 1/2	

DOUBLE-THROW, FRONT-CONNECTED, 45-DEGREE MOUNTING

200	4500	7500	16	370806	34	3	..	30	13 1/2	13 1/2	14 1/2	1 1/2	3 3/4
400	4500	7500	16	370807	34	3	..	30	13 1/2	13 1/2	14 1/2	1 1/2	3 3/4
200	7500	15000	16	370808	43	4	..	30	17 1/2	14 1/2	15 1/2	1 1/2	6
400	7500	15000	16	370809	43	4	..	30	17 1/2	14 1/2	16 1/2	1 1/2	6
600	7500	15000	16	370810	43	4	..	30	18 1/2	15 1/2	16 1/2	1 1/2	6
200	15000	25000	16	370811	44	4	..	30	19 1/2	17 1/2	18 1/2	1 1/2	7
400	15000	25000	16	370812	44	4	..	30	19 1/2	17 1/2	19 1/2	1 1/2	7
600	15000	25000	16	370813	44	4	..	30	20 1/2	18 1/2	19 1/2	1 1/2	7
1200	15000	25000	16	370814	44	4	..	30	22 1/2	20 1/2	22 1/2	1 1/2	7
2000	15000	25000	16	370815	44	4	..	30	21 1/2	19 1/2	21 1/2	1 1/2	7
200	25000	35000	16	370816	60	5	3	30	26 1/2	22 1/2	25 1/2	1 1/2	9
400	25000	35000	16	370817	60	5	3	30	26 1/2	22 1/2	25 1/2	1 1/2	9
600	25000	35000	16	370818	60	5	3	30	26 1/2	22 1/2	24 1/2	1 1/2	9
1200	25000	35000	16	370819	60	5	3	30	28 1/2	24 1/2	26 1/2	1 1/2	9
200	37000	45000	16	370820	60	5	3	30	26 1/2	23 1/2	26 1/2	1 1/2	10 1/2
400	37000	45000	16	370821	60	5	3	30	26 1/2	23 1/2	26 1/2	1 1/2	10 1/2
600	37000	45000	16	370822	60	5	3	30	26 1/2	23 1/2	25 1/2	1 1/2	10 1/2
1200	37000	45000	16	370823	60	5	3	30	28 1/2	25 1/2	27 1/2	1 1/2	10 1/2

SELECTOR, INVERTED MOUNTING

400	4500	7500	13	370834	34	3	..	30	..	..	..	..	..
400	7500	15000	13	370835	34	4	..	30	..	..	..	..	..
800	7500	15000	13	370836	34	4	..	30	..	..	..	..	..
400	15000	25000	13	370837	40	4	..	36	..	..	..	..	..
800	15000	25000	13	370838	40	4	..	36	..	..	..	..	..
1200	15000	25000	13	370839	40	4	..	36	..	..	..	..	..
2000	15000	25000	13	370773	40	4	..	36	..	..	..	..	..

\*The outline drawings showing Type S and Type R disconnecting switches are intended to represent the general outlines of these switches. The drawings do not cover the details of all the ratings listed in the table but do apply in detail, however, to the rating given as a caption. Taken as a group, these drawings show all features for the different ratings and classifications.

†For base and mounting bolt dimensions refer to Fig. 20, page 108.

The dimensions are for reference only. For official dimensions apply to the nearest district office.



DISCONNECTING SWITCHES—Continued

\*OUTLINE DIMENSIONS—Continued

TYPE R DISCONNECTING SWITCHES—Continued

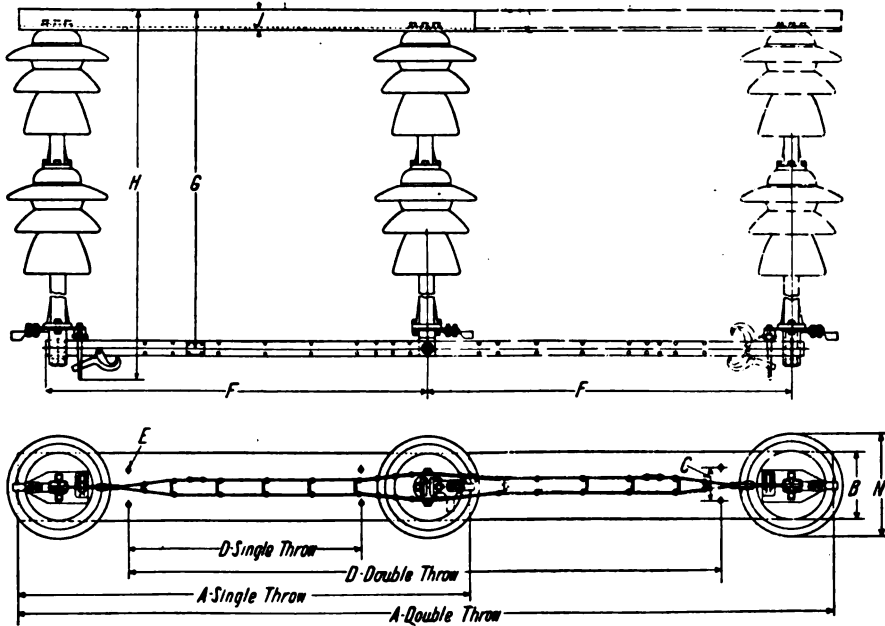


FIG. 17—TYPE R, 400 AMPERES, 110,000 VOLTS

SELECTOR, 45-DEGREE MOUNTING

Amps.	VOLTS		Figure No.	Style No.	DIMENSIONS IN INCHES				
	Outdoor	Indoor			†A	†B	†C	†D	†E
400	4500	7500	16	370840	34	3	..	30	3/4
400	7500	15000	16	370841	43	4	..	30	3/4
800	7500	15000	16	370842	43	4	..	30	3/4
400	15000	25000	16	370843	44	4	..	30	3/4
800	15000	25000	16	370844	44	4	..	30	3/4
1200	15000	25000	16	370845	44	4	..	30	3/4
2000	15000	25000	16	370815	44	4	..	30	3/4

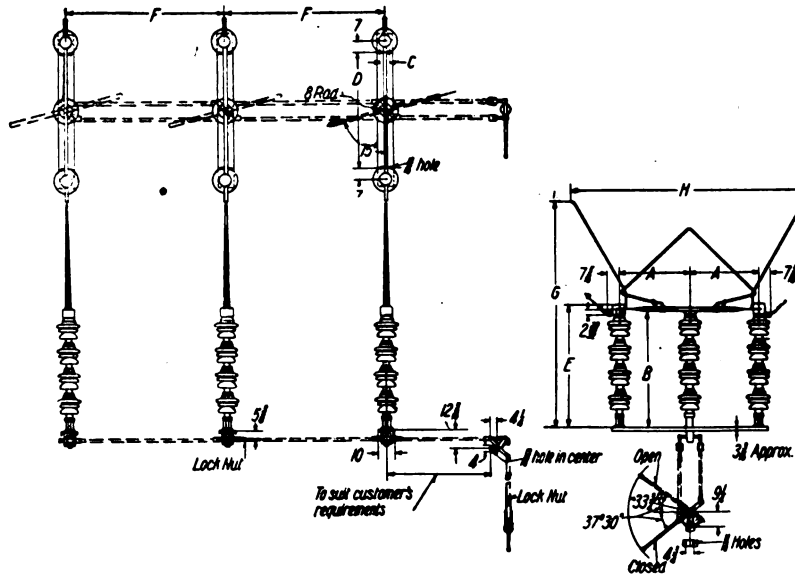


FIG. 18—TYPE R, 400 AMPERES, 154,000 VOLTS REMOTE CONTROL

\*See first footnote, page 106.

†For base and mounting bolt dimensions refer to Fig. 20, page 108.

The dimensions are for reference only. For official dimensions apply to the nearest district office.

DISCONNECTING SWITCHES—Continued  
 OUTLINE DIMENSIONS—Continued

TYPE R DISCONNECTING SWITCHES—Continued

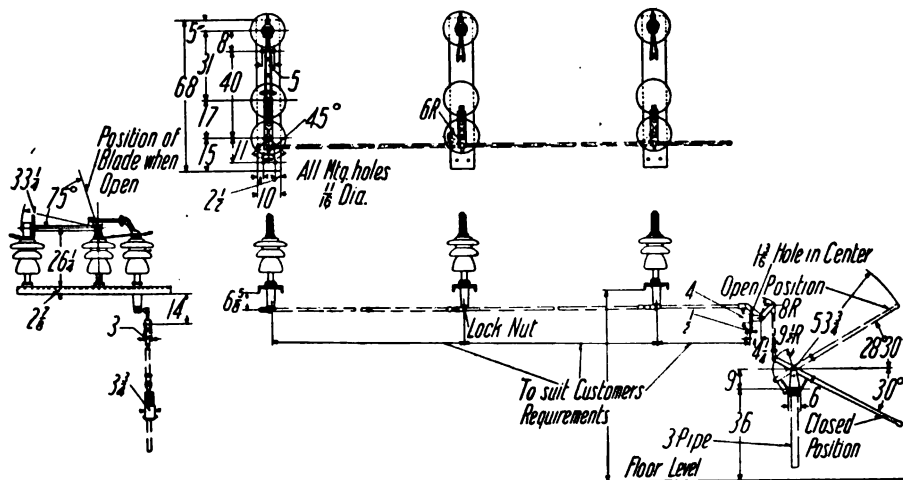
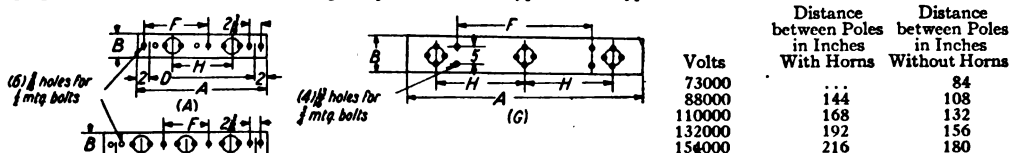


FIG. 19—TYPE R, 400 AND 600 AMPERES, 73,000 VOLTS, REMOTE CONTROL

Amps.	Volts	Figure No.	Style No.	REMOTE CONTROL DIMENSIONS IN INCHES						†F	G	H
				A	B	C	D	E	‡			
				<b>With Horns</b>								
400	88000	18	370852	30	47 1/4	6	46	49 3/4	To Suit	96	104	
400	110000	18	370853	30	47 1/4	6	46	49 3/4	Customer's	96	104	
400	132000	18	370854	33	55 1/4	6 1/4	52	57 3/4	Requirements	129	126	
400	154000	18	370855	42	70 1/4	6 1/4	70	72 3/4	Requirements	144	144	
				<b>Without Horns</b>								
400	73000	19	370846	..	..	..	..	..	..	..	..	
600	73000	19	370847	..	..	..	..	..	..	..	..	
400	88000	18	370848	30	47 1/4	6	46	49 3/4	To Suit	..	..	
400	110000	18	370849	30	47 1/4	6	46	49 3/4	Customer's	..	..	
400	132000	18	370850	33	55 1/4	6 1/4	52	57 3/4	Requirements	..	..	
400	154000	18	370851	42	70 1/4	6 1/4	70	72 3/4	Requirements	..	..	

†There are no accepted standards. This spacing is governed by arrangement of conductors and local conditions tending to cause an arc between poles. If arcing horns are required, increase pole spacing to suit requirements. The following figures are recommended for average requirements with type RV and type RH.



STANDARDIZATION OF TYPE R DISCONNECTING SWITCH BASE PLATES

Volts	Inverted or Wall Mounting	Figure No.	DIMENSIONS IN INCHES					
			A	B	D	F	G	H
<b>Single Throw</b>								
4500	Inverted	20A	24	3	20	12	..	8 1/2
4500	Wall	20A	24	3	20	12	..	10
7500	Inverted	20A	24	4	20	12	..	8 1/2
7500	Wall	20A	28	4	24	12	..	14
15000	Inverted	20A	24	4	20	12	..	12
15000	Wall	20A	30	4	26	12	..	16
25000	Inverted	20D	34	5	30	12	..	18
25000	Wall	20D	40	5	36	12	..	22
37000	Inverted	20D	34	5	30	12	..	18
37000	Wall	20D	40	5	36	12	..	22
50000	Inverted	20D	44	6	40	20	..	26
73000	Inverted	20D	44	6	40	20	..	31
88000	Inverted	20F	54	8	..	30	..	42
110000	Inverted	20F	66	10	..	40	..	54
<b>Double Throw</b>								
4500	Inverted	20B	34	3	30	12	..	8 1/2
4500	Wall	20B	34	3	30	12	..	10
7500	Inverted	20B	34	4	30	12	..	8 1/2
7500	Wall	20C	43	4	30	12	..	40
15000	Inverted	20B	40	4	36	12	..	12
15000	Wall	20C	44	4	30	12	..	42
25000	Inverted	20E	48	5	26	20	..	44
25000	Wall	20E	60	5	30	20	..	56
37000	Inverted	20E	48	5	26	20	..	44
37000	Wall	20E	60	5	30	20	..	56
50000	Inverted	20E	64	6	40	30	..	60
73000	Inverted	20E	74	6	50	30	70	31
88000	Inverted	20G	96	8	..	70	..	42
110000	Inverted	20G	120	10	..	90	..	54

FIG. 20—TYPE R, BASE-PLATE DRILLINGS

The dimensions are for reference only. For official dimensions apply to the nearest district office.

## TYPE T HORN-GAP SWITCHES

MANUALLY-OPERATED, NON-AUTOMATIC, SINGLE-THROW,  
FOR OUTDOOR SERVICE

For Capacities up to 200 Amperes, 66,000 Volts, Alternating Current

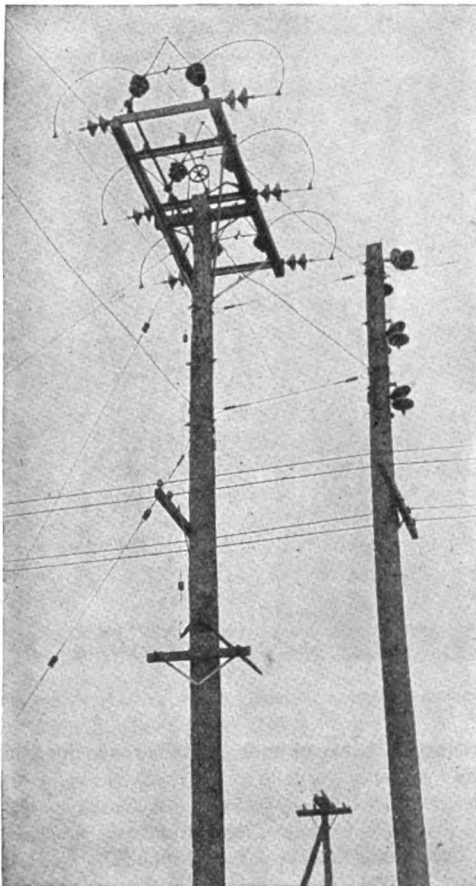


FIG. 1—TYPE T-FC HORN-GAP SWITCH FOR 200-AMPERE, 44,000-VOLT SERVICE. (CLOSED POSITION.)

**Application**—The type T horn-gap switch, in reality a manually-operated, non-automatic, single-throw, air-break circuit-breaker for mounting on top of poles or structures, is primarily used for outdoor service under all weather conditions. This switch can be used in very many cases for switching power loads, changing of transformers from line to

line, etc., where the expense of the more costly oil circuit-breaker is not warranted. Its principal fields of application are (1) switching at sub-stations to cut off the transformer bank from the transmission line; (2) line sectionalizing; (3) controlling branch feeders from the main transmission line; (4) controlling individual consumers' installations, etc. These switches are designed to rupture 1800 kv-a. of transformer charging current at normal rated voltage.

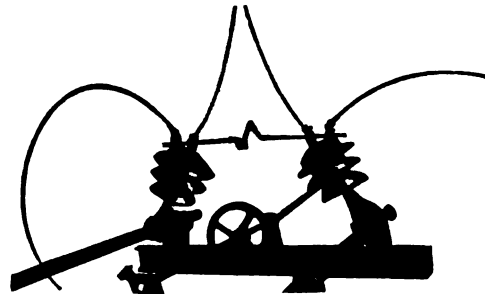


FIG. 2—TYPE T-FC HORN-GAP SWITCH FOR 200-AMPERE, 44,000-VOLT SERVICE. (CLOSED POSITION.) SINGLE-POLE, SHOWING DETAILS OF CONSTRUCTION

**Distinctive Features**—Some of the distinguishing features are: Simple but strong construction; minimum number of parts; non-freezing; positive in action; easy operation; quick opening; self-aligning contacts; contacts for all phases easily adjusted to "register" correctly; interchangeability of parts; ease and simplicity of installation.

**Operation**—A movement of the operating handle, figures 5 and 6, will exert a "pull" on one of the pull wires, which revolves the operating wheel and thus the crank located on the auxiliary shaft with it. The motion, multiplied in force by a toggle mechanism at the instant the greatest force is needed, is transmitted to the main shafts through steel connecting bars and twelve-inch cranks clamped there-to. The result is the opening or closing of the switch, depending upon the direction of movement of the operating handle.

TYPE T HORN-GAP SWITCHES—Continued

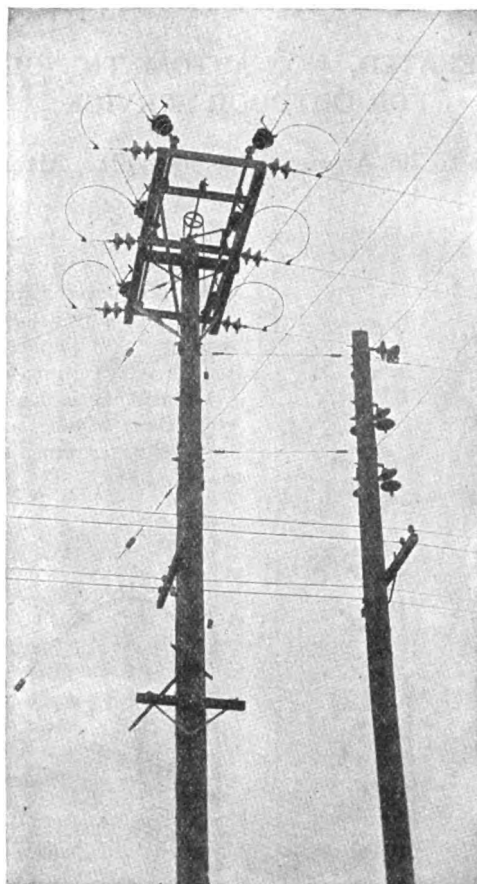


FIG. 3—TYPE T-FC HORN-GAP SWITCH FOR 200-AMPERE, 44,000-VOLT SERVICE. (OPEN POSITION.)

In the closed position the insulators stand at an angle of 30° with the vertical, and on opening rotate through approximately 55°.

Distance between ends of the horns in open position:

The switches have the following clearances:

Distance between poles:

22,000 to 44,000 Volts — 6 feet 0 inches  
66,000 Volts — 8 feet 0 inches

22,000 Volts — 7 feet 0 inches  
33,000 Volts — 7 feet 2 inches  
44,000 Volts — 7 feet 4 inches  
66,000 Volts — 8 feet 2 inches

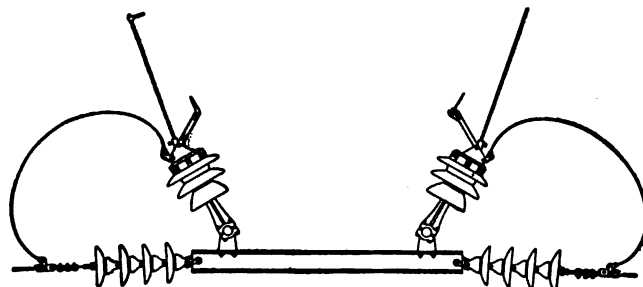


FIG. 4—TYPE T-FC HORN-GAP SWITCH FOR 200-AMPERE, 44,000-VOLT SERVICE. (OPEN POSITION.) SINGLE-POLE, SHOWING DETAILS OF CONSTRUCTION.

## TYPE T HORN-GAP SWITCHES—Continued

Distance between main contacts in open position:

22,000 Volts	— 3 feet 6 inches
33,000 Volts	— 3 feet 8 inches
44,000 Volts	— 3 feet 10 inches
66,000 Volts	— 5 feet 0 inches

The operating mechanism is so constructed that with the switch in either position, a very slight

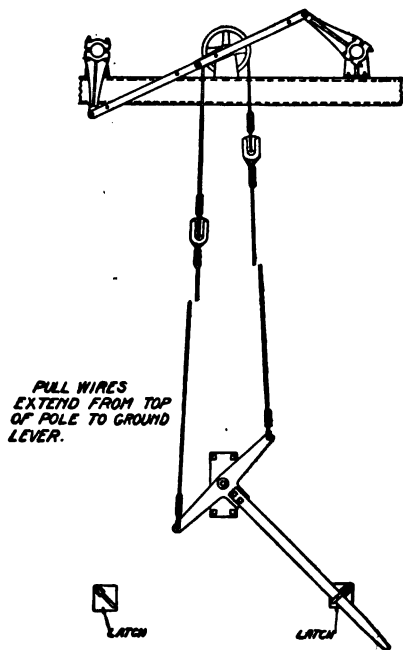


FIG. 5—TYPE T HORN-GAP SWITCH MANUALLY-OPERATED MECHANISM (CLOSED POSITION)

pressure exerted on the manually-operated lever is transformed into a large effort through a toggle joint tending to open or close the switch, and thereby insures against the freezing of rotating parts. This same construction principle in the operating mechanism insures against shock or blow to the insulators. With constant speed on the manually-operated lever, the contacts and rotating parts accelerate from zero through a maximum to zero in a speed curve, nearly a perfect harmonic or sine wave. The result is that the switch comes to rest in either the closed or open position at the time the manually-operated lever hits its corresponding latch stop.

The type T switches open in a vertical plane (See figures 1 and 3) usually parallel with the lines. The main contacts open first, followed by the opening of the auxiliary-horn-arcing contacts, thereby eliminating any burning of the main contacts. This type has the advantage in that it is not necessary to depend upon the natural characteristic of the arc to rise to the end of the horns; but the arc is immediately started at the tips of the horns high above the main contacts, and is at once drawn to a rupturing length, introducing an increasing re-

sistance in the circuit so that the power behind the arc cannot maintain it and thereby interrupts the (decreasing-current) arc high above the main contacts and "grounded" switch parts. This prevents the arc from being held down by wind pressure and insures a more rapid opening of the circuit. It also eliminates the possibility of a short-circuit between phases through the arcs. The large span or gap between horn tips when the switch is in the open position, figures 3 and 8, is to be particularly noted. The length of this gap is important in breaking the arcs resulting from interrupting power loads, low power-factor or charging currents, etc., which the switch may be called upon to handle.

**Construction**—The type T horn-gap switches are manufactured in two forms; the type T-FC, figure 1, and the type T-FO, figure 7. The type T-FC switch (figures 1 and 3) receives its name from the flexible connectors which connect each switch pole terminal to the line. This switch is usually used for all applications except where the line enters a station, when the type T-FO switch may be used. The type T-FO switch (figures 7 and 8) receives its name from the "outboard" insulator (on the station end) in addition to the flexible line connector (on the line end).

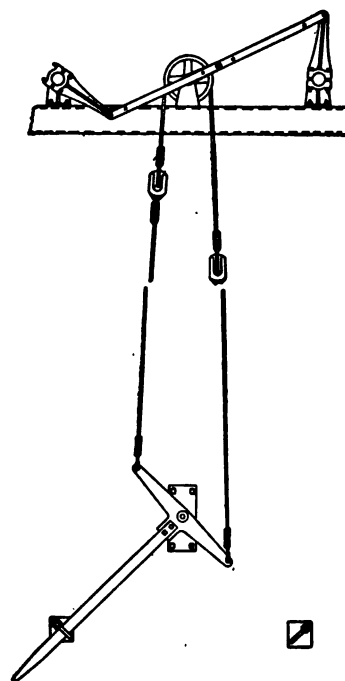


FIG. 6—TYPE T HORN-GAP SWITCH MANUALLY-OPERATED MECHANISM (OPEN POSITION)

The type T switches are of the single-vertical-break type and are supported upon channel-iron bases with the channel turned edgewise. The ends of the channels (one end in the type T-FO switch) are drilled for mounting strain insulators used in dead-ending the line on either side (one side in the

## TYPE T HORN-GAP SWITCHES—Continued

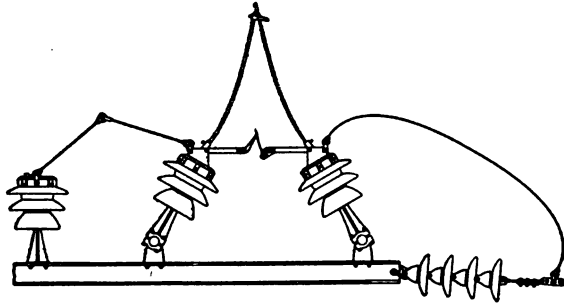


FIG. 7—TYPE T-FO HORN-GAP SWITCH FOR 200-AMPERE  
44,000-VOLT SERVICE  
(CLOSED POSITION)

type T-FO switch) of the contacts through **flexible connectors**. Each end of the flexible connector is equipped with a shunted-joint connector, figure 9. **These shunted-joint connectors** consist of a casting which clamps on to the line wire or forms a part of the saddle clamp for the tube carrying the switch contacts on one end and on the other end connects to the flexible lead; a braided-copper shunt is clamped to the stirrup of this casting and to the shank of the companion casting, thereby giving a very satisfactory flexible joint.

**The main contacts**, figure 10, are carried on brass tubes clamped to the insulator caps by the saddle clamps of the flexible connector and of the arcing horns. This permits the centering of contacts between supporting insulators by sliding, and of a rotating adjustment for final alignment (registering) of contacts. The main contacts of cast copper are screwed and sweated onto the brass supporting tubes and consist of (a) twenty-two 0.102 inch (diameter) round phosphor-bronze spring wires soldered to a grooved copper strip at one end, which in turn is clamped (figure 10) on to one copper block by another copper block; the free ends, when the switch has closed, firmly seat themselves by a wiping stroke in (b) circular-bottomed grooves (twenty-six provided) of the companion copper contact block. This construction gives contacts which will not freeze electrically and which readily remove snow or ice when the switch is closed or opened.

**The auxiliary-horn-arcing contacts**, one of which carries a V-shaped guide to insure proper contact on closing or opening, are carried in brass saddle-clamp

castings fastened to the insulator caps over and in contact with the main contact-supporting tubes.

**The insulator caps**, carrying the main and auxiliary-horn-arcing contacts, are fastened to Westinghouse Faradoid insulators, which have a high factor of safety, by six clamping screws and a two-piece clamping ring in such a manner that the rim of the insulator head is under compression.

**The Faradoid insulators** (see pages of this catalogue on porcelain insulators for full description) are equipped with thimbles and mounted upon metal pins clamped to the main shaft of two-inch extra strong galvanized iron pipe. The main shafts in turn are supported by galvanized cast-iron bearings mounted upon the channel-iron bases.

**The operating mechanism** consists of two twelve-inch straight cranks, one clamped to each main horizontal shaft and each connected to the rotating crank by two steel bars, drilled at their ends to receive pins in the main and rotating cranks. The rotating crank is rigidly pinned to the end of an auxiliary steel shaft, supported midway between the main shafts by cast-iron bearings mounted upon the channel-iron bases. The auxiliary shaft also carries the operating wheel in addition to the rotating crank. The grooved operating wheel, with one turn of wire rope thread thereto, is connected to the cast-iron manually-operated lever located near the ground, by pull-wires as shown in figures 5 and 6. The operating lever latches are so constructed that the switch can be locked in either the closed or open position.

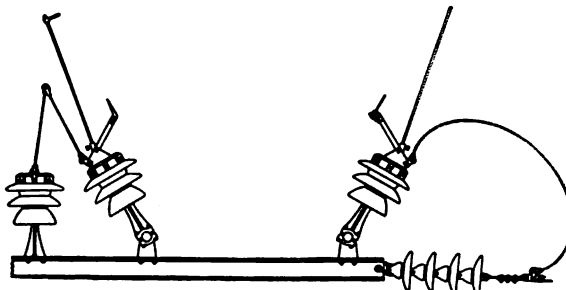


FIG. 8—TYPE T-FO HORN-GAP SWITCH FOR 200-AMPERE,  
44,000-VOLT SERVICE.  
(OPEN POSITION)

## TYPE T HORN-GAP SWITCHES—Continued

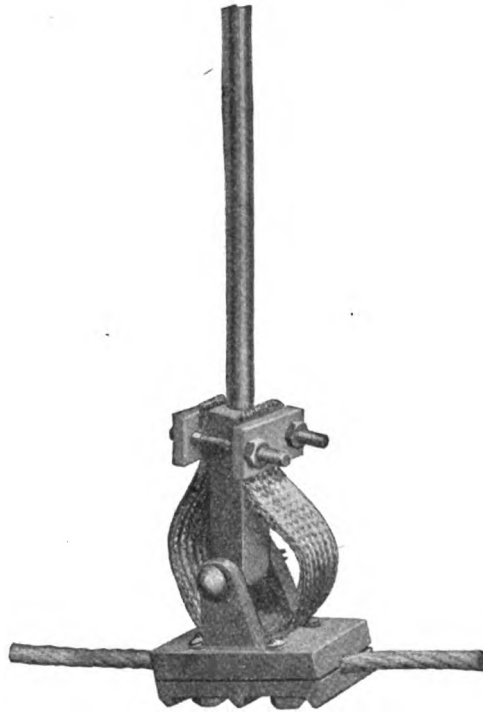


FIG. 9—SHUNTED-JOINT CONNECTOR USED WITH TYPE T HORN-GAP SWITCHES

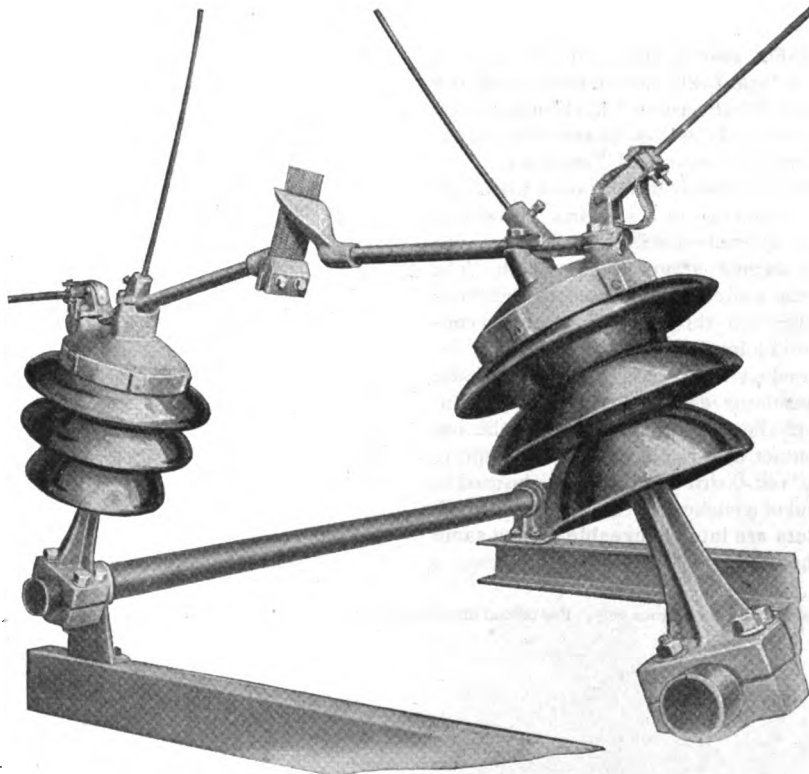


FIG. 10—MAIN CONTACTS SHOWING DETAILS FOR THE 200-AMPERE, TYPE T HORN-GAP SWITCHES

TYPE T HORN-GAP SWITCHES—Continued

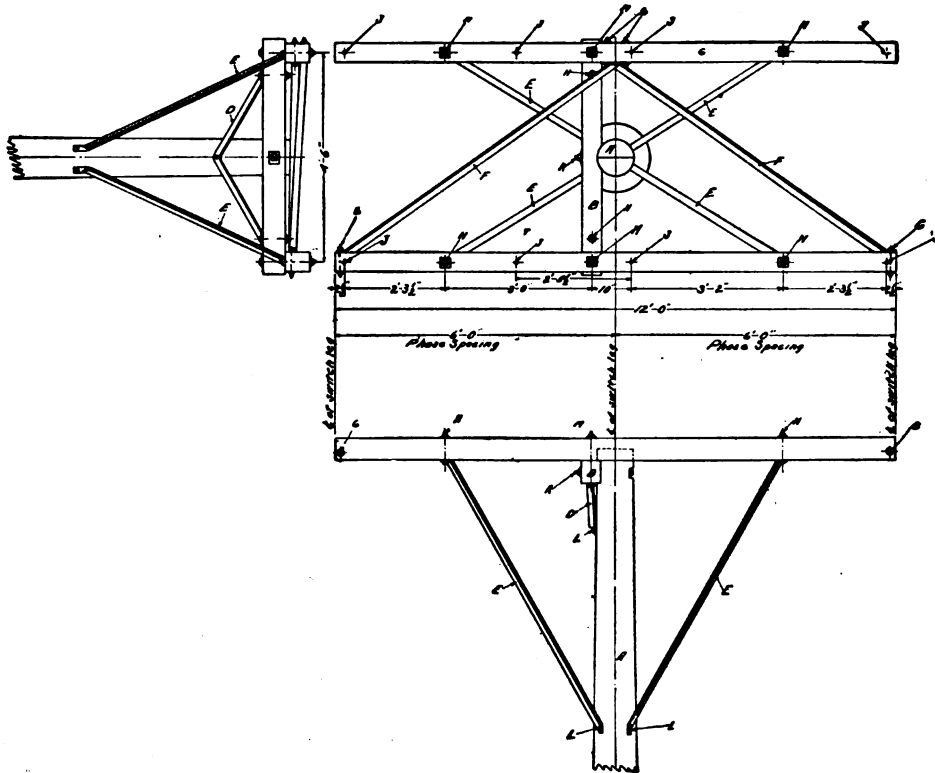


FIG. 11—SUGGESTED FRAMING FOR A SINGLE-WOODEN-POLE MOUNTING FOR THE 22,000 TO 44,000-VOLT TYPE T HORN-GAP SWITCHES

The type T-FO switch, figures 7 and 8, is a duplicate of the type T-FC switch, except only one end of the channel-iron base is drilled for fastening a strain insulator, and the base is extended on the other end to carry an "out-board" insulator.

The type T-FO switch is usually used where the line enters or terminates in a station. The switch is connected to the line by flexible connectors on one side, the same as in the type T-FC switch. The other side of the switch is connected to the "out-board" insulator cap through a pantograph connector. Shunted-joint connectors (previously described) are used at both the switch end and the "out-board" insulator end of the pantograph connector. The middle contact is secured by the use of a hinged contact held in place by two cup spring washers. The "out-board" insulator may be used to support one end of a choke coil, fuse or other device.

The insulators are interchangeable for the same voltage switches.

Bill of Material to Be Furnished by Customer

Switch—22,000 to 44,000 Volts  
Mounting—On One Wooden Pole

Symbol	Pieces Required	Description
A	1	9" Top Pole
B	1	5"x6"x5' Cross Arm
C	2	5"x6"x12' Stringers
D	1	Angle X Arm Brace
E	4	7' Alley Arm Braces
F	2	7' Alley Arm Braces
G	4	1/4"x6" Bolts
H	6	1/4"x8" Bolts
J	8	1/4"x8" Bolts
K	1	1/4"x14" Through Bolts
L	12	1/4"x5" Lag Bolts
M	2	1/4"x14" Bolts
	20	1/4"x2 1/4" Sq. Washers
	1	3"x4"x4'-0" Cross Arm
	1	1/4"x20" Bolt—Pole Butt
	12	1/4" Wrought Washers

85-ft. No. 6 Galvanized Iron Guy Wire

These dimensions are for reference only. For official dimensions apply to the nearest district office.



TYPE T HORN-GAP SWITCHES—Continued

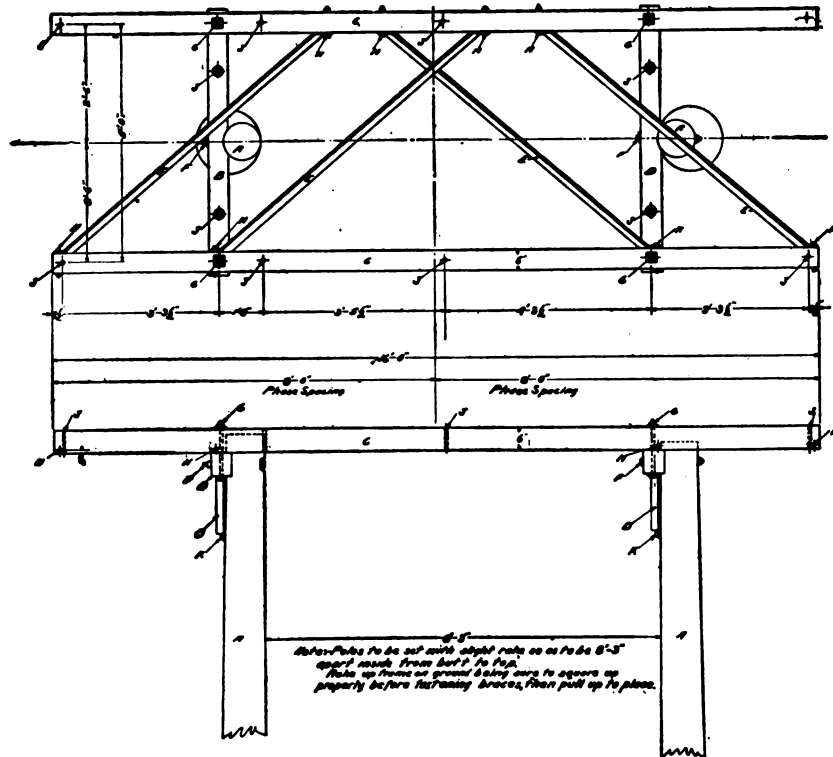


FIG. 12—FRAMING FOR A TWO-WOODEN-POLE MOUNTING FOR THE 66,000-VOLT TYPE T HORN-GAP SWITCHES

Bill of Material to Be Furnished by Customer

Switch—66,000 Volts

Mounting—Two Wooden Poles

Symbol	Pieces Required	Description
A	2	9' Top Pole
B	2	5'x6'x5'-6" Cross Arms
C	2	5'x6'x16'-0" Stringers
D	2	Angle "X" Arm Braces
E	4	7' Alley Arm Braces
F	2	3/4"x16" Through Bolts
G	4	3/4"x14" Bolts
H	8	3/4"x6" Bolts
J	12	3/4"x8" Bolts
K	10	3/4"x5" Lags
	12	3/4" Sq. Washers
	12	3/4" Rd. Washers
	1	4'x5'x4'0" Cross Arm
	1	3/4" Bolt—Pole Butt

85-ft. No. 6 Galvanized Iron Wire

The contact insulator pins for the 22,000 and 33,000 and 44,000-volt switches are interchangeable, also those of the 66,000-volt switches. This same condition also exists for the "out-board" insulator pin of the type T-FO switch.

All copper and brass parts are dipped and lacquered.

All iron or steel bolts and nuts are sherardized.

All iron and steel parts, except bolts and nuts, including channel-iron bases are hot galvanized in accordance with N. E. L. A. Standards.

The entire switch frame-work and operating handle should be well grounded by separate ground wires (and grounds) to accord with the accepted practice for high-voltage construction.

All switches will stand insulation tests at least equal to that given in A. I. E. E. Standardization Rules.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE T HORN-GAP SWITCHES—Continued

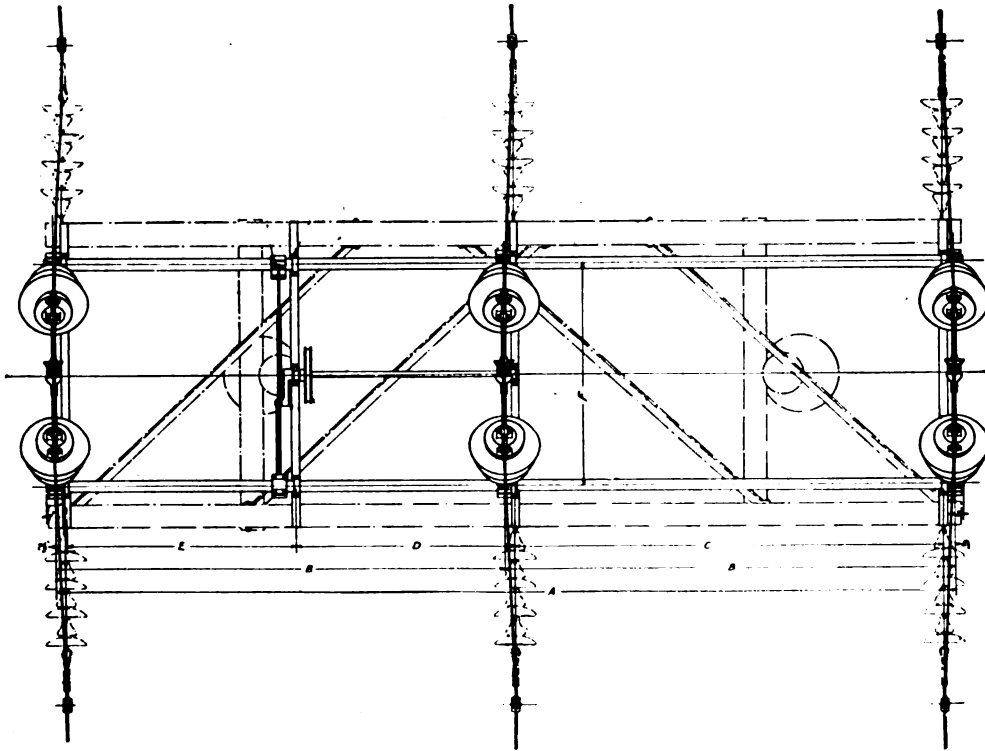


FIG. 13—TYPE T-FC HORN-GAP SWITCH SHOWING TYPICAL PLAN VIEW WITH A TWO-WOODEN-POLE MOUNTING

Voltage	DIMENSIONS					
	A	B	C	D	E	F
22,000 to 44,000	12'-0"	6'-0"	5'-5½"	2'- 5½"	3'-8 "	3'-6"
55,000 to 66,000	16'-0"	8'-0"	7'-7 "	3'-10½"	4'-1½"	4'-0"

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

PRICES

Type T Horn-Gap Switches

Three-Pole, Single-Throw, Non-Automatic\*

Max. Continuous Amps.	Paradoid Ins. No.	Normal Voltage	TYPE T-FC			TYPE T-FO				
			APPROX. WT., LBS. Net	LBS. Ship.	Style No.	List Price	APPROX. WT., LBS. Net	LBS. Ship.	Style No.	List Price
200	2-22	22000	450	650	305952	\$276 00	550	800	305957	\$360 00
200	2-33	33000	495	720	305953	335 00	620	910	305958	470 00
200	3-44	44000	540	775	305954	500 00	700	1020	305959	660 00
200	3-66	66000	725	1085	305956	805 00	970	1400	305961	990 00

\*Prices and data for 2-pole switches furnished on request.

List Price and Style Number include: Switch proper complete, pull wire between the grooved-wheel and strain insulators (approximately 4 feet from the wheel), manually-operating handle and latches.

List Price and Style Number do not include: Supporting poles, or framework for switch, strain insulators (neither line nor pull wire), pull wire between strain insulators and operating handle, nor latch support.

Order by Style Number

## TYPE FL FARM-LINE SWITCHES

SINGLE-PHASE AND THREE-PHASE—TWO AND THREE-POLE  
2500, 7500 AND 15,000 VOLTS

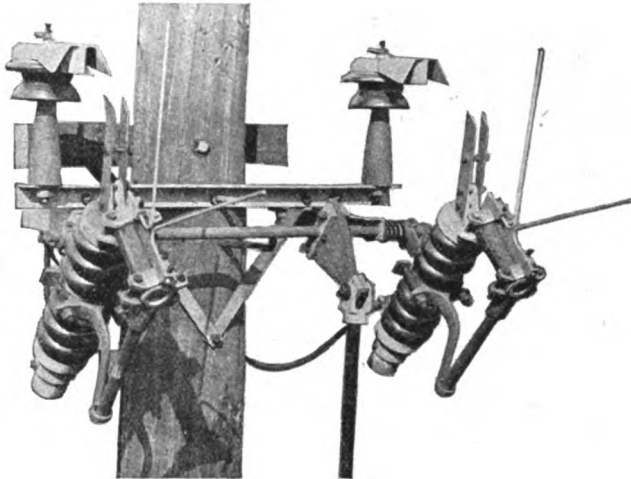


FIG. 1—TYPE FL COMBINED FUSE, LIGHTNING ARRESTER AND REMOTE-MANUALLY-OPERATED SWITCH (OPEN POSITION)

**Application**—The type FL switch is used to control and protect small outdoor distributing transformer installations which may supply power and light to farms, grain elevators, mines, quarries, brickyards and numerous other similar applications. As indicated by the type letters, FL, this device consists of a combination of fuse, lightning arrester and disconnecting switch.

In addition to being an excellent service switch for applications requiring power or lighting 24 hours a day, this switch is admirably adapted for such applications as grain elevators, which are operated only periodically. The use of the type FL switch greatly facilitates in disconnecting the transformer. When the switch is in the open position, the no-load losses of the transformer are prevented.

**Capacity**—These switches are listed for single-phase and three-phase (2- and 3-pole) 2500, 7500 and 15,000-volt service. They are intended for applications not exceeding, approximately, 50 kilovolt-amperes capacity.

**Construction**—As shown in Fig. 1, this combination switching equipment is of strong construction and all metal parts which are exposed to the weather have a durable galvanized finish. The line insulator is of the Paradoid type and the pillar-type insulator which supports various parts of the device is a single piece of porcelain.

The fuse is of the expulsion type. It is mounted in the hollow center of the large pillar-type porcelain insulator. The fuse consists of a casing having contacts at each end, between which the aluminum

fuse wire is connected. The fuse unit is removed from the inside of the porcelain insulator by giving the metal cap at its lower end a quarter turn; the metal cap is provided with a bayonet-form of catch, which locks the fuse securely in place. The fuse is provided with an indicating device, consisting of a telltale target which drops and hangs suspended from the bottom of the fuse unit when the fuse is blown. This indicating device makes it unnecessary in the case of trouble to needlessly climb the pole, as the telltale device shows at a glance from the ground when a fuse is blown. Incidentally, renewals with this type of expulsion fuse are less expensive than with any other form of fuse.

The lightning arrester operates on the horn-gap and series-resistance principle. The spacing of the

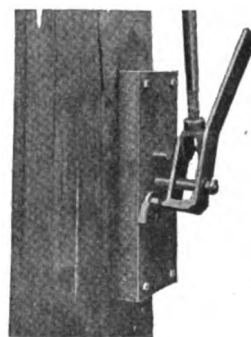


FIG. 2—OPERATING HANDLE OF TYPE FL SWITCH

TYPE FL FARM-LINE SWITCHES—Continued



FIG. 3—  
EXPULSION-  
TYPE  
FUSE  
UNIT.\*

gap between the horns can be varied by means of set screws. The length of the horns is ample to assure positive interruption and dissipation of the arc. The amount of the series resistance is so chosen as to limit the discharge current to a value that can be easily and quickly interrupted by the horn gap, yet it is low enough to assure a sufficient freedom of discharge. The series resistance consists of a special-composition carbon rod with ferrule-type contacts on each end.

The switch is operated by means of the handle shown in Fig. 2, which can be secured by a padlock in the open or closed position. This operating handle, by means of a pull rod, and a common operating shaft, opens or closes all pole units simultaneously. The operating handle, is well insulated from the common operating shaft by means of an insulated link. This feature might be unnecessary, inasmuch as the metal framework of the switch is solidly grounded, but this insulating

link is furnished to form a positive means of protection against any danger to the operator. The moving contact is attached to the upper end of the pillar-type insulator and makes a sliding self-cleaned contact on the under side of the sleet-hood, protecting the stationary contact.

Three-pole equipments are similar in construction to that shown in Fig. 1; the third pole unit is identical in appearance with the others and is operated from the common operating shaft in the same method as described for the two-pole switch.

Complete dimensions of two and three-pole switches for the various voltages, and the single-line diagram of connections are given in the figures below.

Ratings and Prices

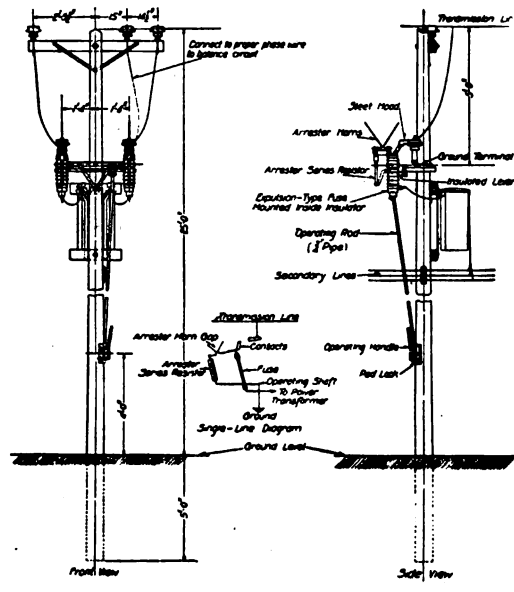
Single-Phase Two-Pole Equipment

Amps.	Voltage	Wt. Lbs., Boxed	Style No.	List Price
25	2500	260	302165	\$170 00
10	7500	285	302167	175 00
5	15000	325	302169	235 00

Three-Phase Three-Pole Equipment

25	2500	400	302166	260 00
10	7500	450	302168	265 00
5	15000	550	302170	350 00

\*Indicator showing blown condition of fuse. When fuse is in operating condition, indicator is held against bottom of fuse.



NOTE: On the three-pole switch the third pole is located at a distance of 20 inches to the right. These dimensions are for reference only. For official dimensions apply to nearest district office.

Order by Style Number

## STEEL TOWERS AND OUTDOOR SUBSTATIONS

**General and Description**—The information given herein covers general data on steel towers and outdoor substations, their application and auxiliaries.

The list prices given in connection with the descriptions of the steel towers, outdoor substations, etc., cover the equipment with the iron or steel having one shop coat of either black graphite or red lead paint.

To obtain the price of a complete station, add the price of the auxiliaries to the price of the station. **The listed price of the station may not apply if there is any variation from the standard design listed.** The auxiliaries listed below are commonly used, but the applications of outdoor stations are so varied that the material may be more or less as required. Prices for these auxiliaries may be obtained from other sections of this catalogue.

- 1—Three-pole type T horn-gap switch.
  - 3—Suspension type D-9 choke coils.
  - 3—Expulsion type fuses.
  - 1—Necessary high and low-voltage strain insulators and bus supports.
  - 1—Lightning arrester, consisting of 3 single-pole autovalve or low-equivalent type for voltages up to 37,000, or one three-phase type AK electrolytic for voltages above 37,000 up to and including 73,000.
- The cuts show typical outdoor transformer substations such as are most frequently found at the end of transmission lines and are intended to give suggestions for the arrangement of equipment. The dimensions of the towers are approximate and may have to be varied considerably to suit the size of transformers used and the arrangement of apparatus for different applications.

Where necessary, the purchaser should provide a protecting fence around the station to keep unauthorized persons a safe distance from the live parts.

The standard spacing between phases for outdoor substation switches for different voltages is as follows:

Voltage	Distance between phases in Feet
7500 and below	4
15000	4
25000	6
37000	6
50000	8
73000	8

**When requesting quotations or placing orders for towers or substations, give the following information.** This information is necessary before we can intelligently quote, or fill the order. The data required is as follows:

- (1) Customer's name and location.
- \* (2) Single-line wiring diagram giving geographical direction of lines and maximum available ground space. It is important that the direction

\*The single-line diagram should be on a separate sheet of paper marked "North" at top, "East" on right, and "South" at bottom.

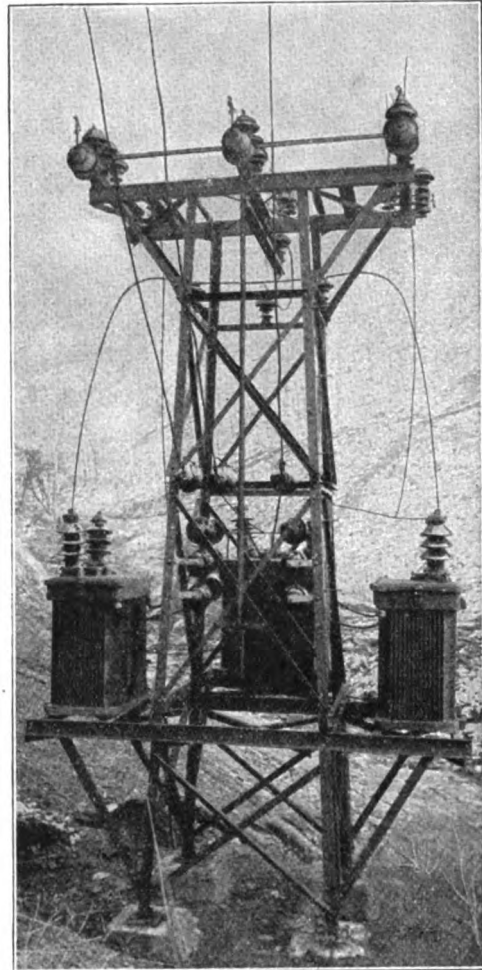


FIG. 1—TYPICAL MODEL P OUTDOOR SUBSTATION

of lines be in geographic synchronism with the ground directions.

- (3) Voltage—high and low.
- (4) Is station receiving or sending station, or both?
- (5) Size, make and characteristics of transformers.
- (6) Number of phases.
- (7) List of apparatus needed, as accurately as possible.
- (8) Height of station.
- (9) Special notes.

**Ground Connection** — The tower should be grounded as shown in the figures. Galvanized pipe of 1½-inch diameter is driven, if possible, 10 feet into the earth. The top of the pipe is then sawed off and copper wire of No. 2 B & S gauge or larger is soldered into the pipe.

STEEL TOWERS AND OUTDOOR SUBSTATIONS—Continued

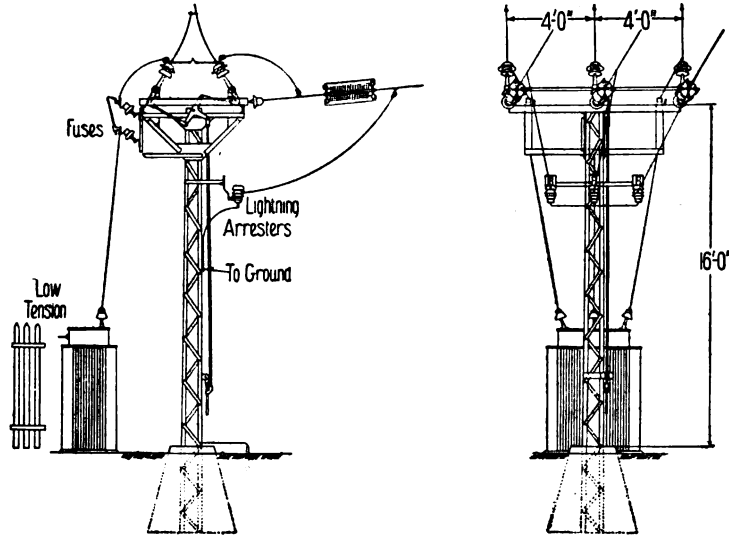


FIG. 2—TERMINAL POLE FOR 7500 VOLTS AND BELOW

**Terminal Pole for 7500-Volt Equipment**

The terminal-pole type of outdoor substation shown in Fig. 2 is generally used for the smaller capacity applications where the voltages are 7500 and below and where the transformer is three-phase and its maximum rating does not exceed 150 kv-a. However, for very small capacity lines, this type of station may often be applied for higher voltages.

The single pole is not convenient where single-phase transformers are to be banked because it is much more difficult to arrange and properly support the high-voltage wiring. In such cases and for low-voltage large-capacity installations it is often advantageous to use two poles with cross ties for supporting the equipment.

The switching equipment necessary for a station of this type can be furnished suitable for mounting

on wood poles where so desired, in which case the purchaser furnishes the wood poles.

**Price**

All steel work for a 7500-volt terminal pole, arranged for 7500-volt equipment as per Fig. 2, and including all erection bolts—

List price..... \$190 00

**37,000-Volt Outdoor Substation**

In Fig. 3 is shown a typical 37,000-volt outdoor substation where the bank of three single-phase transformers is mounted in the tower above the ground. Three 200 kv-a. transformers represent the maximum capacity for a station of this type.

Approximately three strain and ten pin and inverted insulators are required for carrying the high- and low-voltage wiring. The total transformer space is 14 feet, 0 inches, by 5 feet 6 inches. The total

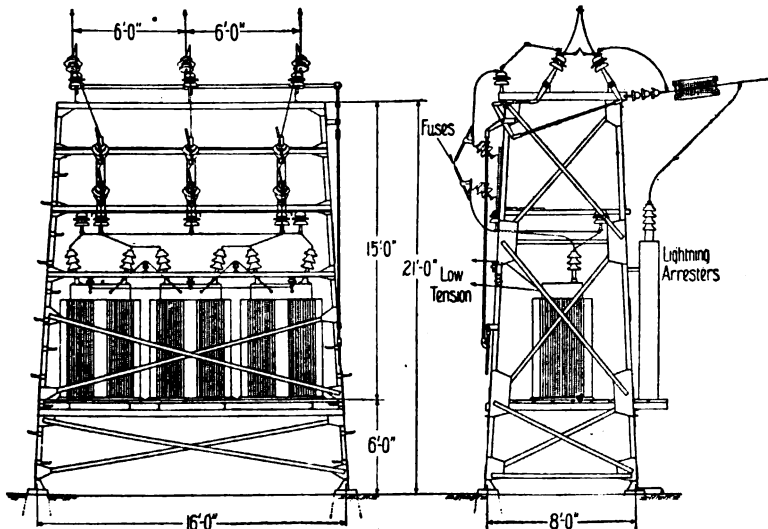


FIG. 3—TYPICAL 37,000-VOLT OUTDOOR SUBSTATION

STEEL TOWERS AND OUTDOOR SUBSTATIONS—Continued

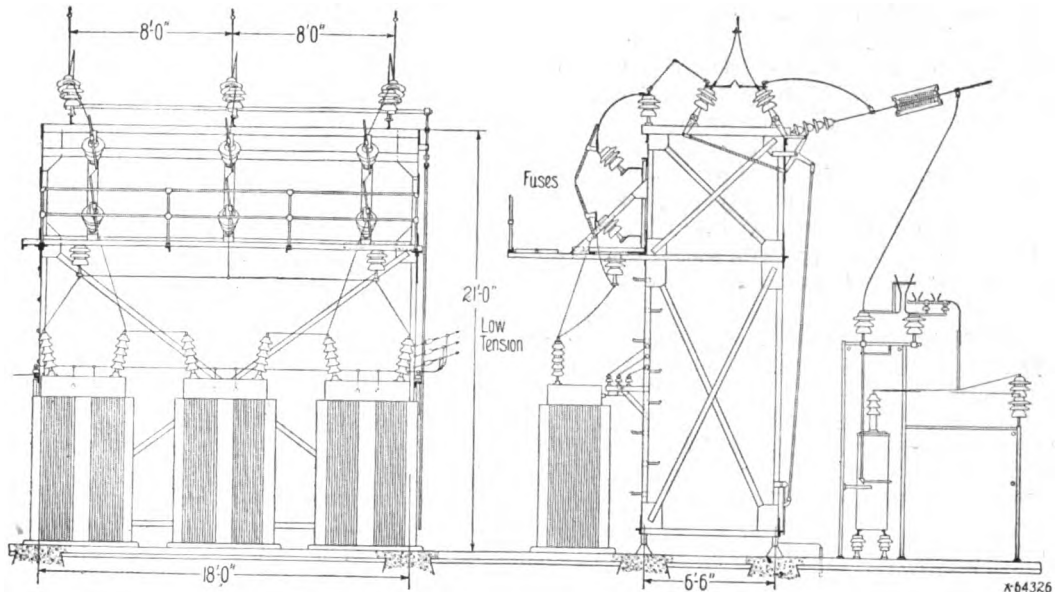


FIG. 4—TYPICAL 50,000-VOLT OUTDOOR SUBSTATION

weight of the transformer should not exceed 15,000 pounds.

This type of station is not limited to 37,000-volt installations but may be applied for voltages either below or above this value if the tower dimensions are modified to provide the necessary spacing between phases and to provide ample room for the transformers. The 6 feet 0 inches spacing between phases as shown in Fig. 3 is correct for 25,000 volts but for 15,000 volts and below the spacing would be reduced to 4 feet 0 inches and other dimensions of the tower would be reduced accordingly, or in so far as the size of the transformers would permit. If the voltage of the towers is above 37,000, the spac-

ing between phases would be increased to 8 feet and the other dimensions of the tower would be modified as required. The maximum voltage on which these stations may be used is 73,000, which is the maximum voltage rating of the type T switch.

**Price**

All steel work for a 37,000-volt substation tower as shown in Fig. 3, including foundation and erection bolts—  
List price..... \$855 00

**50,000-Volt Outdoor Substation**

A typical arrangement for a 50,000-volt outdoor substation is shown in Fig. 4. The dimensions of the

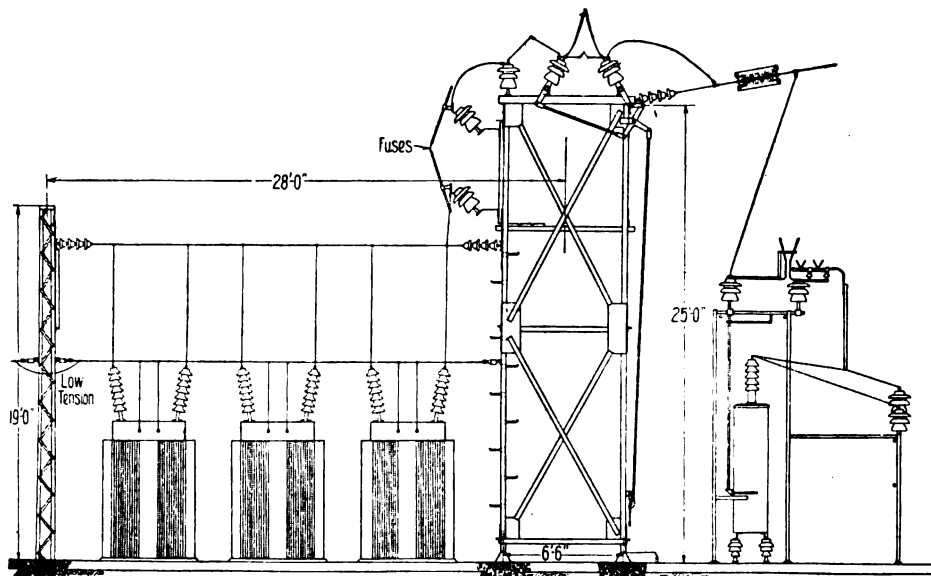


FIG. 5—TYPICAL 73,000-VOLT OUTDOOR SUBSTATION

STEEL TOWERS AND OUTDOOR SUBSTATIONS—Continued

tower are practically independent of the size of transformers used, inasmuch as the transformers are placed on the ground at the side of the tower. However, a check should always be made to insure that there is ample space between the top of the high-voltage terminals of the transformers and the tower platform for the high-voltage connections. The capacity of a station of this type is limited only by the safe rupturing capacity of the high voltage fuses, and for ordinary installations the maximum rating of the three-phase transformer bank should not exceed 2500 kv-a.

Approximately three strain and eight pin and inverted insulators are required for carrying the high-voltage wiring.

This type of station may be applied also for voltages below or above 50,000 volts up to a maximum of 73,000 volts, if the tower dimensions are modified to provide the required spacing between phases.

**Price**

All steel work for a 50,000-volt substation tower as per Fig. 4, including foundation and erection bolts—  
 List price..... \$880 00

**73,000-Volt Outdoor Substation**

Fig. 5 shows a typical arrangement for a 73,000-volt outdoor substation where the switching equipment is mounted on a tower and the transformers are placed on the ground in a line perpendicular to the length of the tower. Two steel poles with cross ties and bracing support the high- and low-voltage bus wiring. The spacing between phases for 73,000 volts is 8 feet 0 inches. The maximum capacity of the three-phase transformer bank should not exceed 2500 kv-a. for usual installations as this is about as high as the rupturing ability of the high-voltage fuses will permit.

Approximately 15 strain insulators are required for carrying the high- and low-voltage wiring.

This station arrangement may also be applied for lower voltages than 73,000, and in such cases the spacing between phases should be made suitable for the voltage and other dimensions should be modified to suit the size and arrangement of the transformers and other apparatus used.

**Price**

All steel work for a 73,000-volt substation as per Fig. 5, including foundation and erection bolts—  
 List price..... \$1040 00

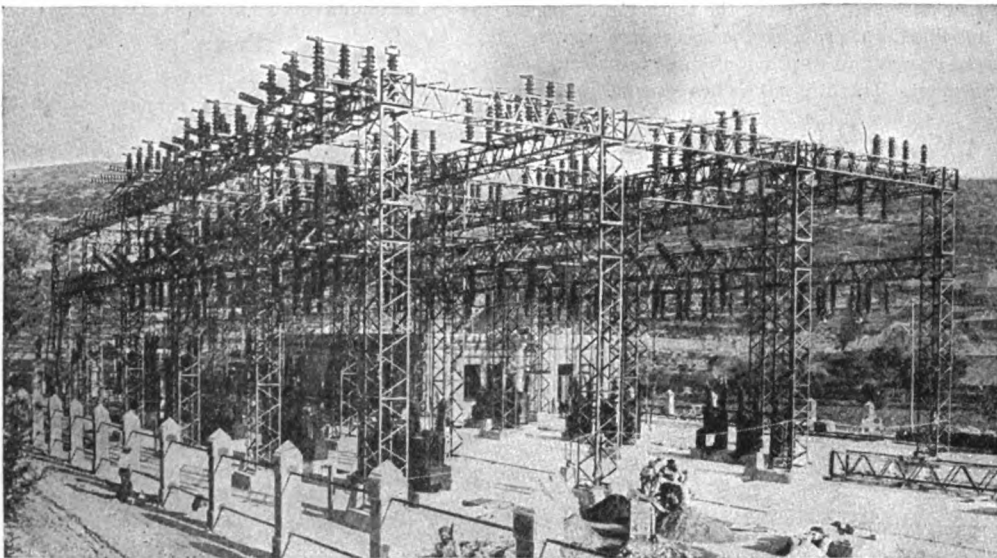


FIG. 7—A SPECIAL HIGH-TENSION OUTDOOR SUBSTATION



## APPLICATION OF CARBON CIRCUIT-BREAKERS

**Temperature**—The current-carrying parts adjacent to the contact surfaces of Westinghouse carbon circuit-breakers will carry their full-rated current continuously with a maximum temperature rise of either 20 degrees or 30 degrees Centigrade, as listed above the temperature of the surrounding atmosphere, and should be applied according to the class of service as recommended below.

**Note**—It is essential that adjacent apparatus does not heat the breaker; that conductors to the breaker are ample to carry the current with a temperature rise not exceeding that of the breaker; and that reasonable ventilation is provided.

The 20-degree rise basis is recommended when the maximum temperature of the air where the breaker is located may approximate 40 degrees Centigrade, or when the load is practically continuous as on some industrial circuits where the load may be steady for 24 hours. When operating conditions are particularly severe, a carbon circuit-breaker should be applied on a 12-degree rise basis. This basis will be explained on request.

The 30-degree rise basis is recommended when the maximum temperature of the air where the breaker is located may approximate 30 degrees Centigrade or less, and the load is intermittent as on railway circuits where the load is steady for one or two hours and then falls off giving the circuit-breaker a chance to cool.

The insulated coils of Westinghouse carbon cir-

cuit-breakers will carry their full-rated current continuously in accordance with article 7101 of the "Standard Rules of the A.I.E.E."


**Current Ratings**—The current ratings shown for all carbon circuit-breakers listed in this catalogue are maximum, based on the allowable temperature rise that is reached after a continuous run of approximately one hour or more at the rated current.

**Application of Rating**—Inasmuch as a circuit-breaker reaches its final temperature quickly with steady current load, it is necessarily a maximum-rated device. In selecting a breaker, it is therefore recommended that the rated capacity should be at least as great as the maximum rated one-hour (or more) overload current of the apparatus that the breaker will be required to control. Thus, if the full-load current of a maximum-rated machine is 2000 amperes, a 2000-ampere-rated circuit-breaker can be applied to handle the current of this machine. If the machine, however, has a 25 per cent overload rating of an hour or more, a 2500-ampere circuit-breaker must be selected.

Owing to the "skin-effect" and eddy-current heating in alternating-current conductors, a circuit-breaker with the same rise in temperature has a lower alternating-current rating than direct-current rating. Also, on 25-cycle service a circuit-breaker above 800 amperes rating will carry, continuously, considerably more than its 60-cycle rating.

### Keys to Symbols Used in Diagrams

 Carbon Circuit-Breaker

 Trip Coil used with Current Transformers and Shunt Trip.

 Closing Coil

 Red Indicating Lamp  
Lights when Circuit-Breaker Closes  
Dark when Circuit-Breaker Opens

 Green Indicating Lamp  
Lights when Circuit-Breaker Closes  
Dark when Circuit-Breaker Opens

 White Indicating Lamp  
Lights when Breaker is Tripped  
by Relay

 6 Pt. Signal Switch.  
Contacts shown for Closed  
Position of Circuit-Breaker.

 6 Pt. Signal Switch.  
Contacts shown for Open  
Position of Circuit-Breaker.

 4 Pt. Signal Switch.  
Contact shown for Open Position  
of Circuit-Breaker.

 4 Pt. Signal Switch.  
Contact shown for Closed Position  
of Circuit-Breaker.

 Control Relay

 Control Switch with  
Lamp Cutout for  
Single-Bus System

APPLICATION OF CARBON CIRCUIT-BREAKERS—Continued

The type CA breakers have an interrupting capacity, when properly connected to the bus-bar system, greater than any existing concentration of power at 750 volts or less. The interrupting capac-

ity of the type CL breakers, while not as great as that of the CA breakers is several times greater than that required by the National Electric Code.

DIAGRAM OF CONNECTIONS FOR CARBON CIRCUIT-BREAKERS

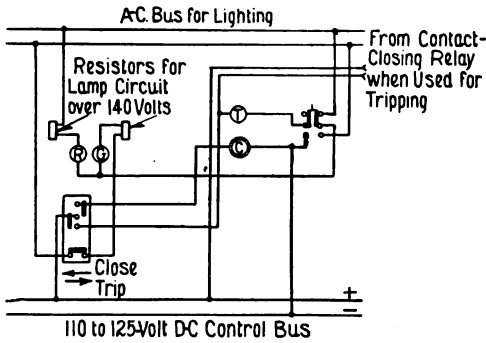


FIG. 1—THREE-WIRE CONTROL, LAMP-CUTOFF CONTACTS, SEPARATE LIGHTING CIRCUIT

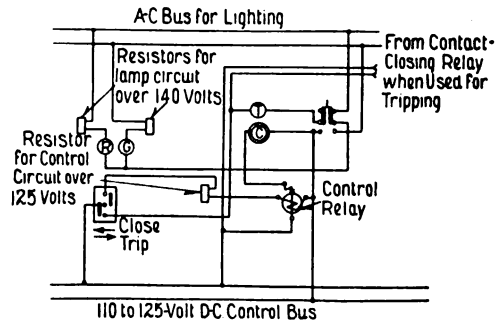


FIG. 2—THREE-WIRE CONTROL, CONTROL RELAY, SEPARATE LIGHTING CIRCUIT

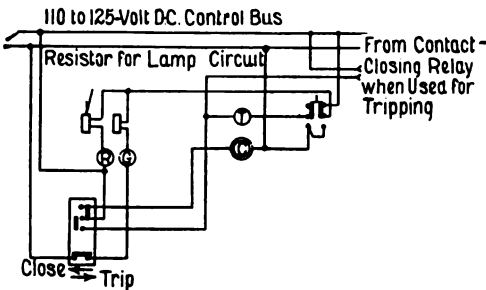


FIG. 3—THREE-WIRE CONTROL, D-C LAMP CIRCUIT WITH LAMP CUTOFF CONTACTS

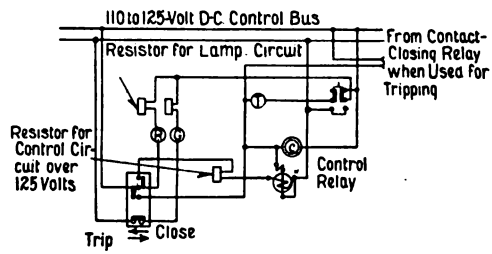
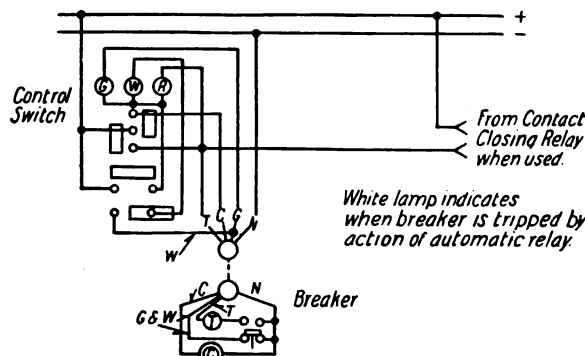


FIG. 4—THREE-WIRE CONTROL, D-C LAMP CIRCUIT, CONTROL RELAY



Four-Wire Control — Three-Lamp Controller

FIG. 5

## APPLICATION OF CARBON CIRCUIT-BREAKERS—Continued

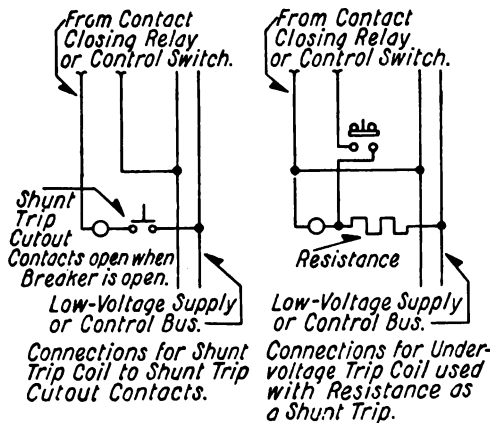


FIG. 6

FIG. 7

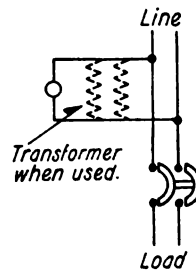


FIG. 8

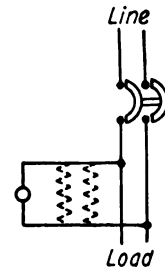


FIG. 9

## CARBON CIRCUIT-BREAKERS, GENERAL

## Types CL and CA

## What to Look For in any Carbon Circuit-Breaker

While the various uses to which carbon circuit-breakers are subjected may require different features in details, certain common points are demanded by modern practice for every breaker. In selecting a breaker it is important, therefore, that the following points be given consideration:

**Space Required**—The modern tendency is to economize in space wherever possible. So much apparatus must be installed in so little space that it is often necessary to choose the smaller of two similar pieces of apparatus. A circuit-breaker that gives the required performance, and at the same time is small, often means considerable saving in space.

**Good Contact**—It is essential that there be good contact between the current-carrying parts of a breaker in order to obtain the maximum current rating. Poor contact produces local heating.

**Efficiency**—A millivolt drop as low as possible is desirable in a circuit-breaker. This is best obtained by having perfect contacts and current-carrying parts of ample size.

**Carrying Capacity**—The carrying capacity of a breaker depends on the contact and conductivity losses, the degree of ventilation, and the allowable temperature rise. The last point is of special significance. In comparing the capacities of different breakers, the allowable temperature rise must be taken into account in order to provide the same basis

of rating for each breaker; otherwise the ratings will not afford a true comparison of capacities.

**Easy Closing**—In order that a circuit-breaker give the best service it must close easily.

**Positive Holding**—To obtain good service on the system, the breaker must be "positive holding," that is, when it is closed, it must stay closed until tripped by one of its tripping devices. Vibration or stray fields should not open it.

**Positive and Quick Release**—When a breaker opens, whether tripped by the operator, by overload, or by any other means, it is absolutely essential that its release be positive and quick so that it breaks the circuit instantly. It should never open sluggishly.

**Self-Cleaning Contacts**—Dust and other foreign particles are liable to lodge on the contacts of carbon circuit-breakers. Repeated opening of the breakers under load will burn the contacts slightly, making them rough. In order that the dust may be cleaned off and that the slightly rough surface may be kept smooth, a breaker should have a self-cleaning action, that is, its contacts should be so arranged that there is a slight wiping action between them when they are opened and closed.

**Easy Adjustment**—A circuit-breaker should be easily adjusted, but when set, its adjustment should be permanent until changed by the operator.

**Reliability**—A circuit-breaker must be reliable. It should have positive operation under all conditions. Better have none on the line at all than have one that cannot be depended upon.

## CARBON CIRCUIT-BREAKERS, GENERAL—Continued

**Simplicity**—Intricate mechanism in a circuit-breaker is apt to be a source of trouble. Simplicity should be looked for in every part.

**Facility for Repairs**—Accidents that cannot be foreseen are always liable to happen and repairs must be sometimes made to the best breaker. A circuit-breaker should be so designed as to facilitate repairing, and thus cause the least possible delay in putting it back in service.

**Caution**—It should be noted, however, that no carbon circuit-breakers are suitable for operation in cement or flour mills, plaster or furniture factories, or any similar industry where acid fumes or excessive dust and dirt are present. For operation in such locations, the installation of oil-circuit breakers is strongly recommended.

Where carbon circuit-breakers are installed in places subject to an accumulation of dust and dirt, special care should be taken to keep the contacts clean and bright. Circuit-breakers that in the course of operation are rarely opened, should be regularly opened and cleaned by the attendant to insure good contact. In these applications, circuit-breakers should be applied on the 20-degree temperature rise basis.

**National Board of Fire Underwriters' Approval**—All Westinghouse carbon circuit-breakers meet requirements of National Board of Fire Underwriters.

### Distinctive Features

Among the distinctive features of the Westinghouse types CL and CA carbon circuit-breakers are: exceptional strength and neatness of appearance; simplicity of construction, operation, and installation; few parts, all easily accessible, and those parts likely to require replacement, easily renewable; great compactness, thus saving in space; long carbon arms, especially long in the case of the CA breakers, giving long break of arcing members; current-carrying parts of ample size so that no portion of breaker will exceed guaranteed temperature rise; main moving contacts are laminated copper brushes, self-wiping or self-cleaning; auxiliary contacts in addition to main contacts; self-aligning, self-cleaning carbon contacts; contact pressure adjustable; low resistance from main contacts to carbon-arcing contacts: small millivolt contact drop; very simple toggle mechanism; all breakers trip easily, quickly and positively; auxiliary tripping and signalling attachments are easily applied.

### Construction

In Westinghouse types CL and CA carbon circuit-breakers special attention has been given the problem of keeping the size of breakers down to a minimum for the required performance. The construction is such that the best possible ventilation is secured, the object being to obtain the maximum radiating surface on all current-carrying parts, and thus insure a breaker of the highest current-carrying capacity for its size.

**Operating Mechanism**—On the mechanically operated breakers, the closing mechanism consists of the

operating handle and the toggle mechanism connecting the handle lever and the main contact arm. On the electrically operated breakers, the closing is effected by means of a direct-current solenoid mounted below the main mechanism. The solenoid plunger is connected to the closing mechanism in such a way that when current flows through the solenoid and the plunger is drawn down, the main contacts are closed.

A distinctive feature of Westinghouse electrically operated carbon circuit-breakers is the liberal use of iron and copper in the closing magnets. By these means a wide range of operating voltage is secured. At the minimum voltage the breaker closes promptly and at higher than minimum voltages the breaker closes with a little greater speed. Measurements show that at maximum voltages the current in the closing coils, while the breakers are closing, is not more than one half the value obtained by dividing the impressed voltage by the ohms resistance on the coil. This phenomenon is caused by the counter-electromotive force produced in the coil by the increase in flux in the magnet during the closing movement of the plunger. An increase in voltage on the closing coil results then in only a relatively slight increase in current and consequently only a slight increase in closing speed, so that there is practically no danger of breaking the carbons even when closing under quite high voltages.

The contacts of these breakers are held closed automatically by a trigger, or latch. The various trip mechanisms are constructed to disengage this latch and permit the breakers to open.

**Main Contacts**—All current-carrying contacts are made of copper. The movable element is a laminated brush composed of several strips of copper and makes an end-on, or butt, contact with the fixed element; this gives a relatively large wiping, or self-cleaning contact when the breaker is closed and insures uniform pressure over the entire contact surface. A high contact pressure is obtained because of the form of mechanism between the handle and contacts. This pressure reduces the heating of the contacts to a minimum and insures a low contact-resistance. A means is provided for adjusting this contact pressure and for equalizing the pressure on both ends of the moving element. For additional information on the main contacts see description of the various types of breakers on the following pages.

**The main contact block** or fixed element, and the **terminal studs** are of two forms: the round threaded form and the slotted-bar or laminated form for laminated connections. In the smaller capacities below 2500 amperes direct-current, they are made up of drawn round or rectangular copper bar stock, electro brazed to form the terminal stud and contact blocks. In the larger capacities, higher than 2000 amperes direct-current, they are "pressure moulded" of extremely high-conductivity copper or are made from laminated bars sweated into solid copper blocks.

The slotted-bar studs are arranged with horizontal laminations in the top stud and vertical laminations

## CARBON CIRCUIT-BREAKERS, GENERAL—Continued

in the bottom stud. Vertical laminations in the top stud or horizontal laminations in the bottom stud can be furnished (special) on order.

**Auxiliary Contacts**—For description of the auxiliary contacts see description of the various types of breakers on the following pages.

Except as hereinafter noted the finish of the Westinghouse types CL and CA carbon circuit-breakers conform to that of Westinghouse switchboard standards. The exposed copper current-carrying parts are polished and all other parts are black marine.

**Multipole Breakers**—Westinghouse types CL and CA carbon circuit-breakers are listed with one, two, three, or four poles. Each multipole breaker is provided with a "common trip," that is, an overload on any one pole trips all the poles.

**Field-Discharge Breaker**—The usual field discharge arrangement consists of either a two-pole or single-pole breaker supplied with shunt trip and field discharge features and is for use in connection with exciter generators or as main field switches to large alternating-current generators. In this service the breaker is usually made non-automatic as the excitation should only be interrupted at the will of the operator. Reverse-current trip is sometimes applied to this field-discharge form of breaker, when it is used as the exciter-generator main switch or breaker.

**Barriers**—Multipole breakers for voltages over 300 volts and sometimes for all voltages over 125 where the poles are placed closer together than standard spacing, must be supplied with barriers between poles in order to prevent arcing over. Barriers are not included with some of the standard breakers but must be ordered separately (see tables of "Accessories" for each type of breaker).

### Operation Characteristics

**Temperature**—Refer to data in pages on "Application of Carbon Circuit-Breakers".

**Dielectric Test**—All Westinghouse carbon circuit-breakers are subjected to a dielectric test for one minute between current-carrying parts and ground, and between terminals, of at least twice their rated voltage plus 1000 volts.

**Interrupting Capacity**—Refer to data in pages on "Application of Carbon Circuit-Breakers".

### Methods of Operation

Under average conditions, for simple plants having not over 10,000 ampere 750-volt units, carbon circuit-breakers can be mounted directly on the switchboard panel. Where the requirements exceed these, remote-controlled breakers mounted apart from the panel and electrically controlled from the panel by an auxiliary circuit become advisable. For 1500-volt service in capacities up to

2500 amperes the single-pole manually-operated remote-control breakers are recommended. Electrically operated remote-controlled breakers are also listed for lower capacities for applications where for other reasons it is preferred not to mount the breaker directly on the panel.

**Manual Operation**—Manual closing by a handle connected directly to the breaker is the ordinary method of closing carbon circuit-breakers. Pulling down on the handle closes the breaker.

**Electric Operation**—In the field of power-operated circuit-breakers the Westinghouse Electric & Manufacturing Company has long adopted as standard the direct-current electrical-solenoid magnet method of closing. This is now used almost universally to the exclusion of various other methods, such as motor, hydraulic and pneumatic closing.

Westinghouse electrically operated carbon circuit-breakers are closed by means of a simple cylindrical magnet mounted below the breaker mechanism. When the closing switch is thrown, current flows through the solenoid and the plunger is drawn down. This closes the contacts, which are held closed automatically by a latch. The solenoid plunger rises when the closing circuit is opened, so that it will not retard the opening of the breaker when tripped. The breaker is opened by the automatic overload trip or by the shunt-trip attachment mounted at the side of the breaker mechanism. The breakers can be tripped manually by pushing back on the insulated-trip handle near the bottom of the breaker.

Standard closing coils are wound for direct current. Direct-current mechanisms, besides being simpler in construction, more reliable in operation, and more easily kept in repair, are much more economical of space and power than alternating-current mechanisms. Alternating-current shunts and current-transformer-trip coils are available on special order.

The closing and tripping mechanisms are operated by a control switch with or without a control relay (see pages on various types of breakers) in the operating circuit, and usually with signal lamps, all of which are described and listed on pages on "Small Oil Circuit-Breaker Accessories." The electric operating mechanism has a small double-throw switch to operate the signal lamps and to open the shunt-trip coil circuit when the circuit-breaker has opened. See Fig. 6 in pages on "Application of Carbon Circuit Breakers" for diagrams.

**Acceleration**—On account of the reaction of the laminated moving contact members, no separate means of accelerating the breaker to its open position are necessary. The laminated members, which act as powerful springs, the toggle-lever springs, the secondary contact springs, and the carbon-arm springs, all serve to accelerate the opening of the breaker.

## CARBON CIRCUIT-BREAKERS, GENERAL—Continued

**Methods of Mounting**

In general, carbon circuit-breakers are shipped on scrap slate or wood panels for remounting on the final switchboard panels. When so specified on the order they will be shipped on black marine slate bases of standard sizes.

**Methods of Tripping**

**Non-Automatic** breakers are simply switches capable of opening overloads, but opened and closed only at the desire of the operator. They can be made automatic through relays operating on a shunt-trip coil.

**Plain-Automatic Overload Trip**—All standard overload-trip carbon circuit-breakers are plain-automatic, that is, when closed with an overload on the line, they will remain closed as long as the closing handle is held down or the closing coil is energized, but will not remain closed when the handle is released or the closing circuit is opened. Multipole manually operated breakers of the "double-arm-trip-free type" can be supplied (see "Accessories").

**Series Trip**—All standard overload-trip carbon breakers are arranged for direct-acting (series) tripping without relays.

**Transformer Trip**—In some cases breakers used on alternating-current circuits can be supplied on special order for transformer tripping. Breakers used on alternating-current circuits and equipped with shunt-trip coils can be made transformer-trip through relays acting on the shunt-trip coils. For information write to the nearest district office.

**Calibration**—The standard range of calibration for automatic-overload trip is from 80 to 160 per cent of the 30 degree rise ampere rating. Breakers can readily be set to trip at any point within their range. Calibration higher than standard can be furnished on special order.

**Accessories**

Attachments for effecting automatic operation of Westinghouse carbon circuit-breakers are described and listed in this catalogue. Additional auxiliaries for electrically operated circuit-breakers, such as control switches, indicating lamps, etc., are listed in the section on "Westinghouse-Oil-Circuit-Breakers." For relays see section on "Westinghouse Instruments and Relays."

**Attachments Applied**—Any single auxiliary-trip attachment is arranged to trip all poles of a multipole carbon circuit-breaker, and therefore one attachment can be used for all poles. If proper space between poles (or pole centers) is allowed, one attachment per pole can be used, if desired.

For information as to whether the tripping attachments described on the following pages can be applied to a particular type of breaker, see pages of description on that type.

**Shunt-Trip Attachment**—The shunt-trip attachment enables the breaker to be tripped electrically from some distant point. A direct-current shunt-trip mechanism is included as standard with each electrically operated breaker and can be supplied as an accessory on almost all manually operated breakers. If the circuit-breaker is not arranged to cut out the shunt-trip circuit (see description on the various types of breakers), signal contacts described below should be provided to do this when the circuit-breaker trips, as the tripping coils are designed for intermittent service only. These standard shunt-trip coils are made for 125-volt direct-current circuits and will trip the circuit-breaker within a range of from 55 per cent to 115 per cent of the normal voltage. Coils to operate on other direct-current voltages or on alternating-current can be supplied on special order.

Non-automatic breakers can be made automatic through relays operating on the shunt-trip coil.

The automatic undervoltage-trip attachment described below, when supplied with a suitable resistor, can be used as a shunt-trip mechanism by momentarily short-circuiting the coil.

**Inverse-Time-Limit Attachment**—An inverse-time-limit dash pot with an adjustable time feature can be used with some of the breakers herein listed. This attachment will cause the breaker to trip almost instantly on heavy overload and much more slowly on light overloads, giving the circuit on light overload the chance to clear the trouble before the breaker trips. For information whether an inverse-time-limit attachment can be applied to any particular breaker see description of that breaker or refer to the nearest district office.

**Automatic Undervoltage-Trip Attachment**—The undervoltage-trip attachment is used to trip the breaker when the line voltage fails or falls approximately 50 per cent or more under the rated normal voltage. It is of particular advantage in automatically disconnecting a motor from the circuit at the time of temporary interruption of the supply circuit, for should the motor come to rest and still be connected to the line it would be subjected to full voltage upon the power being restored. The automatic undervoltage-trip attachments listed for Westinghouse carbon circuit-breakers are reset by hand or automatically on the opening of the breakers according to description in tables listing them.

Only one undervoltage attachment is necessary with multipole breakers. No additional protection is afforded by the use of a coil across each phase of a two-phase or three-phase circuit for the reason that the motors, when the voltage of one phase fails, will run single-phase and feed back into the idle phase, thus preventing the undervoltage device from acting; but the resulting overload on the working phase, due to the entire load being on that phase, will trip a properly set breaker.

The undervoltage-trip attachment, if supplied with suitable resistor, can be used also as a shunt-trip attachment by momentarily short-circuiting the coil.

## CARBON CIRCUIT-BREAKERS, GENERAL—Continued

**Automatic Reverse-Current Trip Attachment—**This attachment is particularly applicable to storage battery charging, or the operation of direct-current generators or synchronous converters in parallel, its function being to disconnect the generator from the bus whenever the current reverses due to any cause, as for example, rise in battery voltage, drop in generator voltage, or stopping of the prime mover. It is not affected by an overload in the normal direction, and can be applied to non-automatic breakers where the reverse-current protection only is desired. The automatic reverse-current trip attachment automatically resets itself after the tripping operation and is prompt and reliable in its action. Two windings are provided, one shunt and the other series, the former having a shunt cutout which automatically opens the circuit when the breaker trips. If desired the tripping current may be obtained from a circuit other than that in which the circuit-breaker is connected.

The tripping range can be easily adjusted by means of the calibrating screw. If the shunt coil is supplied with normal voltage, the attachment can be set to trip the breaker at any current value from 5 per cent of normal rating in the reverse direction to 25 per cent of normal rating in the negative, or reverse direction. The amperes required to trip the breaker will be only slightly affected by small changes in voltage.

A series resistance is required in the shunt-coil circuit for the higher voltages.

The magnets of the attachment for types CL and CA circuit-breakers are so arranged that with current flowing in the normal direction, they tend to hold the armature against movement but when the current in the series coil reverses, they tend to cause the armature to lift and trip the breaker.

**Automatic Overvoltage-Trip Attachment—**The automatic overvoltage-trip attachment is used principally in connection with storage battery charging, where it is desired to cut off the current supply when the battery becomes fully charged. It may, however, be used in any alternating-current or direct-current circuit which it is desired to open automatically in case of either moderate or abnormal rise in voltage.

On alternating-current circuits and direct-current circuits below 130 volts the coil is connected directly across the circuits, but in direct-current circuits over 130 volts, a series resistance is used. The tripping circuit may be entirely distinct from the breaker circuit.

The tripping range is exceedingly wide, the maximum point being 100 per cent greater than the minimum voltage calibration. No permanent magnets are used in the construction of this attachment. It trips the breaker directly and consequently requires no shunt-trip auxiliary attachment.

**Automatic Underload-Trip Attachment —** The automatic underload-trip attachment is principally used on storage battery-charging circuits. When

the charging current decreases to a certain predetermined value, the breaker is tripped; the circuit is thus opened and the chance of current flowing back from the battery to the generator and causing trouble is thus avoided. For this application the attachment is generally set to trip at 10 per cent of normal load; but the standard attachments can be set to trip at any point from 10 to 25 per cent.

The automatic underload-trip attachments listed are reset by hand or automatically by the opening of the breaker, according to the description in the tables listing them.

**Signal Contacts—**For use as shunt-trip cut-outs and in operating signal lamps, a single-pole double-throw plunger switch that automatically closes one signal circuit when the breaker is closed and another when it is open is listed. This attachment is fastened to the panel and is operated by an insulated rod actuated from the moving main-contact brush of the breaker. It has a switching capacity ranging from 10 amperes at 125 volts to 1 ampere at 750 volts.

**Bell-Alarm Contacts—**For this service any small double-throw single-pole switch may be used in conjunction with the signal switch above referred to, for indicating by lamps, bells, or other signal, the operation of the breaker. The signal contact switch is connected as a single-pole, double-throw switch; and, in conjunction with the single-pole, double-throw bell-alarm cut-out switch, makes the necessary connections to ring a bell or operate a signal when the breaker is in the position opposite that desired by the operator.

**Relays—**Where a more reliable time-limit is required for selective operation of circuit-breakers than can be provided by the type of dashpot described above, protective relays should be used in connection with the circuit-breaker shunt-trip coils. For a description of the selective protection possible with relays and for relay connection diagrams, see section on "Westinghouse Instruments and Relays." The use of relays in connection with an auxiliary source of direct-current power for tripping obviates the use of overload coils and time-limit feature on the circuit-breaker.

**Control Relays** for use in the closing-coil circuit of electrically-operated single-pole and multipole breakers are listed in the section of this catalogue on "Switchboard Accessories." These control relays are not required except as noted on pages on the various types of breakers.

**Double-Arm Attachment—**The double-arm attachment eliminates the necessity for switches in series with a two-pole single-handle breaker in low-capacity and low-voltage service and at the same time affords full automatic protection to the circuit throughout the closing period. With this arrangement, each pole of the breaker is closed independently and in succession, so that the pole first closed is left free to open while the second or

**CARBON CIRCUIT-BREAKERS, GENERAL—Continued**

final pole is being thrown in. The breaker being closed, an overload in either positive or negative line, or both, will trip both poles simultaneously.

This double-arm common-trip attachment is used with two identical standard single-pole circuit-breakers either front or rear-connected, each with standard single-pole independent closing handle. It can easily be added to breaker already mounted, provided the center to center distance between poles is as given in the table, in which case no modification of the breaker is required to install the attachment.

Where the double-arm feature is desired for two phase four-wire service, we recommend the closing of one leg of each phase with one two-pole single-handle breaker and completing the circuit by closing the remaining two-pole single-handle breaker, using the "double-arm" common trip feature to connect the poles of the four-pole structure.

**Trip-Free-on-Overload Attachment**—The trip-free-on-overload attachment (also known as "full-automatic-overload trip") on a breaker makes it impossible to hold the breaker in a closed position while a continued overload condition or short-circuit exists on the line.

This feature can be supplied on special order on electrically operated or manually operated remote-controlled breakers.

Full-automatic or "trip-free" operation particularly on direct-hand-controlled carbon breakers is not recommended for high-capacity circuits or for service of over 250 volts, d-c., or 440 volts, a-c. Carbon breakers should not be closed on a circuit under heavy load. Another switch should be used to close the circuit, especially on an overload; otherwise damage to the secondary and carbon contacts, or injury to the operator, may result.

## INSTRUCTIONS FOR ORDERING CARBON CIRCUIT-BREAKERS

**Style number and list price include** the breaker complete ready for installation, but without attachments, control switches, signal lamps, or relays.

Rear-connected round-stud breakers are furnished with clamp and contact nuts equivalent to the breaker rating.

A cable terminal (or terminals) is furnished for rear-connected, round-stud breakers on one stud of all poles of types CL and CA breakers of 800-ampere capacity and below. Cable terminals for one stud of all poles of 1000 and 1200-ampere capacity type CA breakers will be supplied without extra charge, if specified as a separate item on the breaker order.

Where cable terminals other than those specified above are required, they should be ordered as a separate item. (Nuts and terminals are listed in the section of this catalogue on "Switchboard Accessories").

The **panel-mounting breakers** are furnished mounted on a wood template, unless otherwise specified in the description on individual types of breakers.

The **separate mounting breakers** are furnished mounted on a black marine slate base unless otherwise specified in the description on individual types of breakers. It is recommended that electrically operated breakers be ordered on their final mounting bases.

**Special circuit-breakers**, or those not fully covered by style number, should be ordered (or quotation requested thereon) by referring to the style number of nearest standard breaker and stating: "Same as

Style Number.....except....." (giving as on all orders):

- Type.
- Amperes.
- Volts.
- Direct-current or alternating-current.
- Cycles.
- Poles (if multipole, closing handles or magnets desired).
- Studs (round or laminated, and if laminated position of lamination).
- Method of trip (automatic, non-automatic or with attachments, giving all characteristics).
- Method of operation (manually operated direct-control; manually operated remote-control; electrically-operated, with range of voltage; 125 volts direct-current is standard).
- Mounting (panel or separate—if separate, characteristics of base as to thickness, etc.).
- Accessories (as designated, with full characteristics).
- Terminals (when ordered give size and number of cables per stud).
- Maximum temperature in degrees of surrounding air, and, in addition, where breakers are to be duplicates of breakers previously furnished, give order number or style numbers.
- Attachments** that are to be assembled with the breaker should be specified as part of the circuit-breaker item and fully described therein.
- Control accessories** not assembled as part of the breaker should be specified as separate items.



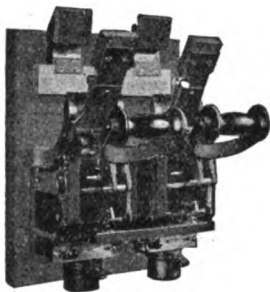
## TYPE CL CARBON CIRCUIT-BREAKERS

Manually or Electrically Operated

For Direct or Alternating-Current Circuits

### Application

Type CL carbon circuit-breakers are designed particularly for 250-volt industrial applications where a compact breaker is required. They may, however, be used on all kinds of service up to 250 volts without barriers and up to 600 volts with barriers between poles.



200-AMPERE TYPE CL CARBON CIRCUIT-BREAKER, TWO POLE, SEPARATE HANDLES, WITH TWO INVERSE-TIME-LIMIT OVERLOAD COILS

Type CL carbon circuit-breakers should not be used for heavy 750-volt railway service. For such service use the type CA line of breakers.

They can be supplied with plain overload, dash-pot time-limit overload, shunt trip, undervoltage trip, underload trip, reverse-current trip, with a single-pole double-throw or double-pole double-throw signal and cutout contact device, with field discharge contacts, and with electric closing and tripping mechanisms.

### Distinctive Features

Short carbon arms and compact construction minimizes amount of head room and space required for mounting of the breaker.

One-piece frame per pole facilitates assembling and the remounting of the breaker from temporary base to permanent switchboard.

Unit construction permits easy assembly and mounting of multipole breakers or of breakers with the different attachments.

Laminated main brush making butt contact with stud block insures high contact pressure and self-cleaning contacts.

Copper parts are of ample capacity to carry rated current.

A powerful toggle mechanism gives easy and positive closing of breaker.

Positive locking device prevents breaker from opening from ordinary shocks.

High grade finish of breaker with satin finish copper parts gives excellent appearance on switchboards.

### Construction

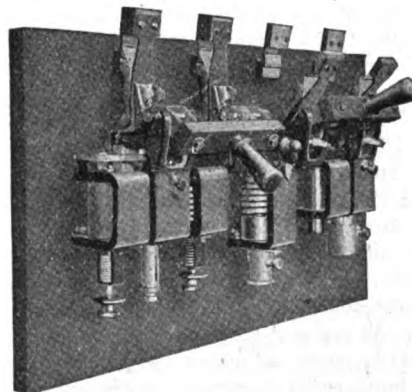
The type CL carbon circuit-breakers are as compact or more compact than any other type of carbon circuit-breaker on the market, of equal conducting and interrupting capacities. The short carbon arm, designed primarily for 250-volt service, but given an opening sufficient for use on 600-volt service, means a minimum amount of head room, which feature should be of special interest for industrial plants.

The pole unit has a one-piece frame so that it can be very readily removed from the temporary panel, used in shipping the breaker, to the final switchboard or moved from one position in the user's plant to another. This feature decreases cost of installation.

The breakers are of the unit construction which means that multipole breakers can be readily assembled from single-pole units with the simple addition of a common trip bar or, if desired, a common trip bar and one closing handle instead of separate closing handles. The various attachments can be easily added to a breaker in the field or assembled with a new breaker.

A powerful toggle mechanism permits very easy yet positive closing of the circuit breaker. Above 200 amperes capacity the breaker is held closed by a roller trigger with a non-rusting steel roller on phosphor-bronze pins.

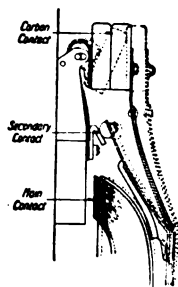
**Main Contacts**—The main contact consists of a set of laminations, each one of which, because of its own spring properties, makes an independent contact at each end with the stationary contact members. The brush, itself, is semi-elliptical in form, the contact surfaces being on the long axis of the ellipse. The ends of the laminations therefore bear with a heavy butt contact pressure against the contact studs and have a substantial sliding motion



200-AMPERE TYPE CL CARBON CIRCUIT-BREAKER, FOUR-POLE, TWO CLOSING HANDLES, ONE PLAIN OVERLOAD COIL, ONE INVERSE-TIME-LIMIT OVERLOAD COIL, ONE UNDERLOAD COIL, ONE UNDERVOLTAGE COIL, ONE REVERSE-CURRENT COIL, AND ONE SHUNT TRIP ATTACHMENT

## TYPE CL CARBON CIRCUIT-BREAKERS—Continued

relative to these studs during the opening and closing of the breaker. This sliding contact tends to break up any oxide film that may have accumulated. The cross section of the main branch is ample to carry the rated current without excessive heating. When the breaker is tripped, the main



## TYPE CL CARBON CIRCUIT-BREAKER CONTACTS

Full lines show the main contacts open, secondary contacts about to open and carbons still closed.

Dotted lines show both the main and secondary contacts open and the carbons about to open.

contacts are opened first and the current is shunted upward through copper secondary contacts to the carbon arcing contacts where the final break takes place.

**Secondary Contacts**—The secondary contacts are located directly above the brush contact. The secondary stationary contact on breakers for 3000 amperes or over have a surface inclined to the vertical and approximately parallel to the frame of support of the moving contact spring, thus preventing buckling of the spring in case the contact is roughened by repeated opening under short-circuit conditions. The moving contact spring is held under initial pressure until just before the contacts close. The secondary contacts open next after the main or brush contacts open, preventing the latter from arcing under severe short-circuit conditions.

**Carbon Contacts**—Large low-resistance carbon contacts, self-aligning and having a self-wiping action, mounted at the end of the carbon arm, give the final break to the arc.

**Connections**—Type CL carbon circuit-breakers are arranged for rear connection. The main contact blocks form part of the terminal stud.

**Handles**—The manually operated direct-control type CL carbon circuit-breakers are provided with a straight handle up to and including 800 amperes, with a spade handle from 1200 amperes to 6000 amperes d-c. rating. Electrically operated breakers are provided with a detachable handle for use in case of failure of voltage on the control bus.

**Studs**—The type CL breakers are furnished with round threaded studs, up to and including 1200 amperes 30-degree d-c. rating and laminated studs for 1600 amperes and above, the laminated studs being horizontally laminated on the top stud and vertically laminated on the bottom stud.

**Field Discharge Breakers**—For the control of generator fields type CL carbon circuit-breakers of either hand or electric operation from 300 amperes to 2000 amperes d-c. rating can be equipped with field discharge contacts. The field discharge switch is so connected to the circuit breaker that it opens just before the breaker closes and closes just before the breaker opens.

**Equalizer circuit-breakers** can be supplied consisting of an extra pole or poles for the equalizer connection. For three-wire generators, these equalizer breakers will consist of a positive and a negative pole, with two equalizer poles of about one half the ampere rating of the positive and negative poles. For two-wire generators, the circuit-breaker will usually consist of a positive, a negative and an equalizer pole. In the case of ground return and railway generator, it will consist of a positive and an equalizer pole.

On special order, the breakers of the following characteristics can be supplied.

## 30-Degree Rating

Positive & Negative Pole or Poles	Equalizer Pole or Poles
*200	100
*300	200
*400	300
*600	600
*800	600
*1200	1800
*1600	1800
*2000	1200
†3000	1600
†4000	2000
†6000	3000

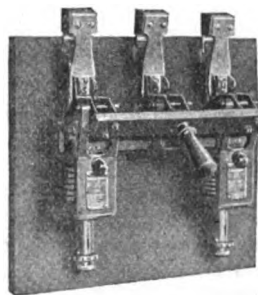
\*These ratings have the positive and negative and equalizer poles mounted in the same size frame and the poles can be closed separately or together, with all poles tripping together.

†These ratings have the equalizer pole mounted in smaller frames than the positive and negative poles. All poles must be closed separately but all poles will trip together.

1800-ampere breakers on same frame as 1200-ampere breakers.

Prices on request.

**Multi-Pole Circuit-Breakers**—Each multi-pole breaker is provided with a common trip, that is, an overload on any one pole trips all poles. The manu-



200-AMPERE TYPE CL CARBON CIRCUIT-BREAKER, THREE-POLE WITH SINGLE HANDLE, TWO PLAIN OVERLOAD COILS

ally operated breakers can be provided with a single closing handle and cross bar for closing all poles together (all poles tripped together). On four-wire two-phase work, it is recommended that one leg of

## TYPE CL CARBON CIRCUIT-BREAKERS—Continued

each phase be closed by means of a two-pole handle and that the other legs of each phase be closed by another two-pole handle. All poles would then be arranged to trip together.

The electrically operated multi-pole breakers can be supplied on special order in any standard number of poles and in any standard ampere capacity in which the type CL line is listed up to and including 400 amperes d-c., with a separate electromagnet for closing each pole and a single shunt trip magnet acting through a common trip mechanism for tripping all poles of the breaker together.

#### Type CL Multi-pole Circuit-Breaker Standard Mounting Centers

##### Distance Between Center Lines of Individual Poles

Amperes Current Rating	Standard Spacings, 250 Volts	
	without Barriers—600 Volts with Barriers.	
Up to 200	4 1/2 inches	
300 and 400	5 inches	
600 and 800	6 inches	
1200 to 2000	7 inches	
3000 and 4000	10 inches	

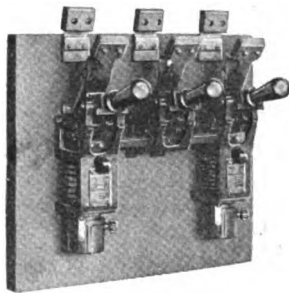
#### Accessories

##### Auxiliary Tripping Attachments

**Attachments Applied:** Any single tripping attachment is arranged to trip all poles of a multi-pole type CL carbon circuit-breaker, and therefore one attachment can be used for all poles. The number of tripping devices usually supplied for type CL carbon circuit-breakers is shown in the following table:

No of Poles	No. of Overload Coils	No. of Under-voltage Trip Coils	No. of Shunt Trip Coils	No. of Underload Trip Coils	No. of Reverse-Current Trip Coils
1	1	1	1	1	1
2	1 or 2	1	1	1	1
3	2 or 3	1	1	2	2
4	2 or 4	1	1	2	2

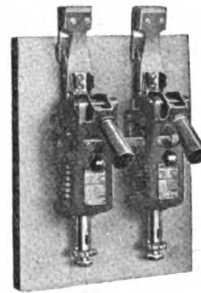
**Shunt Trip Attachments—**The shunt trip attachment for the type CL carbon breaker can be mounted on either the right hand or left-hand side of the breaker pole as desired. Where either position is equally convenient it is recommended that it be mounted on the right-hand side. In rating up to 200 amperes where the circuit-breaker has a pole not equipped with an overload device, the shunt



200-AMPERE TYPE CL CARBON CIRCUIT-BREAKER, THREE-POLE WITH SEPARATE CLOSING HANDLES, TWO INVERSE-TIME LIMIT OVERLOAD COILS

trip may be an integral part of this pole unit, thus making a saving in space required by the breaker on the panels.

**Undervoltage Trip Attachment—**The d-c. and a-c. undervoltage trip attachments can be made to mount on either side of the breaker poles but where either side is convenient, it is recommended that it be mounted on the left-hand side so as not to interfere with the standard mounting of the shunt trip attachment. In rating up to and including 200 amperes, the undervoltage trip can be incorporated in the breaker pole, the same as described for the



200-AMPERE TYPE CL CARBON CIRCUIT-BREAKER, TWO-POLE WITH SEPARATE HANDLES, TWO PLAIN OVERLOAD COILS

shunt trip attachment. The under-voltage trip attachment is set to release at approximately 50% of the rated voltage. The attachment is reset by hand before closing the circuit breaker.

**Inverse-Time-Limit Attachment—**An inverse-time-limit dashpot overload device can be supplied for any of the type CL carbon breakers. In ratings up to 400 amperes, it will introduce a time delay between the occurrence of the overload and the tripping of the breaker approximately inversely proportional to the magnitude of the overload. For ratings above 600 amperes, direct-current, the inverse-time-limit is the same as the above except that the time delay is adjustable from zero to the maximum for any degree of overload. When the overload is very large the time becomes the same as would be the case if the breaker were equipped with plain overload.

#### Barriers

Barriers are not included with the standard breakers and where needed should be ordered separately from pages listing accessories.

#### Bases

Unless otherwise specified upon entry of order, standard breakers will be shipped on scrap slate or wood templates. When specified at time of entry of order, black marine slate bases of standard sizes will be furnished at no additional price.

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



SINGLE-POLE  
REAR-CONNECTED  
PLAIN OVERLOAD

For 600 Volts Maximum

MAX. AMPS.*		Approximate Shipping Weight, Lbs.	Style No.	List Price
30° Rating	20° Rating			
<b>For Direct Current</b>				
12½	12½	10	323320	\$ 44 00
25	25	10	323321	44 00
50	50	10	323322	51 00
75	75	10	323323	51 00
100	100	10	323324	54 00
150	150	10.	323325	60 00
200	200	10	323326	67 00
300	250	16	370955	78 00
400	350	18	370956	90 00
600	500	32	370957	119 00
800	650	38	370958	138 00
1200	1000	50	370959	191 00
1600	1200	59	370960	234 00
2000	1600	67	370961	300 00
3000	2400	111	370962	423 00
4000	3000	137	370963	540 00
6000	5000	260	370964	810 00

For Alternating Current†

12½	12½	10	371363	44 00
25	25	10	371364	44 00
50	50	10	371365	51 00
75	75	10	371366	51 00
100	100	10	371367	54 00
150	150	10	371368	60 00
200	200	10	371369	67 00
300	250	16	371370	78 00
400	350	18	371371	90 00
600	500	32	371372	119 00
800	650	38	371373	138 00
1000	900	50	371374	191 00
1200	1000	59	371375	234 00
1600	1200	67	371376	300 00
2400	2000	111	371377	423 00
3000	2500	131	371378	540 00
4000	3000	260	371379	810 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

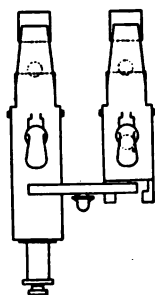
**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip, or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

\*Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

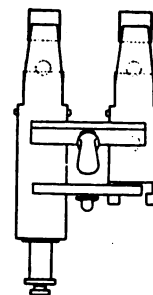
†Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25 cycles up to and including 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800 amperes refer to pages preceding the tables of ratings.

Order by Style Number

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



**TWO-POLE  
REAR-CONNECTED  
SINGLE-COIL  
PLAIN OVERLOAD**  
For 250\* Volts Maximum



MAX. AMPS.†		Approximate Shipping Weight, Lbs.	STYLE No.		List Price
30° Rating	20° Rating		Separate Closing Handles	Single Closing Handle	
<b>For Direct Current</b>					
12 1/2	12 1/2	16	370979	371089	\$ 70 00
25	25	16	370980	371070	70 00
50	50	16	370981	371071	80 00
75	75	16	370982	371072	80 00
100	100	16	370983	371073	83 00
150	150	16	370984	371074	93 00
200	200	16	370985	371075	102 00
300	250	26	370986	371076	121 00
400	350	30	370987	371077	139 00
600	500	38	370988	371078	175 00
800	650	48	370989	371079	211 00
1200	1000	77	370990	371080	285 00
1600	1200	95	370991	371081	387 00
2000	1600	112	370992	371082	480 00
3000	2500	210	370993	.....	770 00
4000	3000	250	370994	.....	1030 00
<b>For Alternating Current‡</b>					
12 1/2	12 1/2	16	371382	371458	70 00
25	25	16	371383	371459	70 00
50	50	16	371384	371460	80 00
75	75	16	371385	371461	80 00
100	100	16	371386	371462	83 00
150	150	16	371387	371463	93 00
200	200	16	371388	371464	102 00
300	250	26	371389	371465	121 00
400	350	30	371390	371466	139 00
600	500	38	371391	371467	175 00
800	650	48	371392	371468	211 00
1000	800	77	371393	371469	285 00
1200	1000	95	371394	371470	387 00
1600	1200	112	371395	371471	480 00
2400	2000	210	371396	.....	770 00
3000	2500	250	371397	.....	1030 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

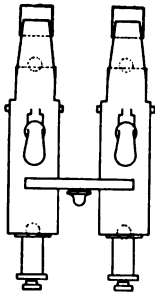
\*The breakers can be used for 600 volts if barriers are added. See additional list price for barriers under "Auxiliaries."

†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

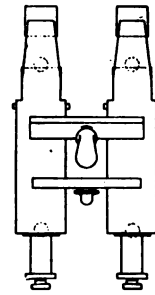
‡Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25 cycles up to and including the 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800 amperes refer to pages preceding the tables of ratings.

Order by Style Number

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



**TWO-POLE  
REAR-CONNECTED  
TWO-COIL  
PLAIN OVERLOAD  
For 250\* Volts Maximum**



MAX. AMPS.†		Approx. Shipping Weight, Lbs.	Separate Closing Handles	STYLE No.	Single Closing Handle	List Price
30° Rating	20° Rating					
<b>For Direct Current</b>						
12 1/2	12 1/2	20	371017		371097	\$ 92 00
25	25	20	371018		371098	92 00
50	50	20	371019		371099	106 00
75	75	20	371020		371100	106 00
100	100	20	371021		371101	112 00
150	150	20	371022		371102	124 00
200	200	20	371023		371103	137 00
300	300	32	371024		371104	160 00
400	350	36	371025		371105	185 00
600	500	64	371026		371106	243 00
800	650	76	371027		371107	282 00
1200	1000	100	371028		371108	387 00
1600	1200	118	371029		371109	498 00
2000	1600	134	371030		371110	630 00
3000	2400	222	371031		.....	880 00
4000	3000	262	371032		.....	1160 00

**For Alternating Current‡**

12 1/2	12 1/2	20	371420		371486	92 00
25	25	20	371421		371487	92 00
50	50	20	371422		371488	106 00
75	75	20	371423		371489	106 00
100	100	20	371424		371490	112 00
150	150	20	371425		371491	124 00
200	200	20	371426		371492	137 00
300	250	32	371427		371493	160 00
400	350	36	371428		371494	185 00
600	500	64	371429		371495	243 00
800	650	76	371430		371496	282 00
1000	800	100	371431		371497	387 00
1200	1000	118	371432		371498	498 00
1600	1200	134	371433		371499	630 00
2400	2000	222	371434		.....	880 00
3000	2500	262	371435		.....	1160 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to pages on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip, or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

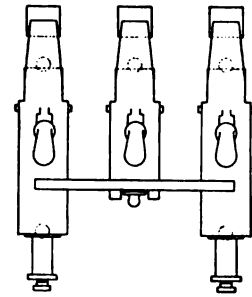
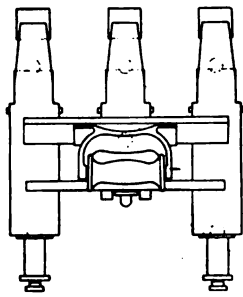
\*The breakers can be used for 600 volts if barriers are added. See additional list price for barriers under "Auxiliaries."

†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

‡Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25 cycles up to and including the 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800 amperes refer to pages preceding the tables of ratings.

*Order by Style Number*

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



**THREE-POLE  
REAR-CONNECTED  
TWO-COIL  
PLAIN OVERLOAD  
For 250\* Volts Maximum**

MAX. AMPS.†		Approximate Shipping Weight, Lbs.	STYLE No.		List Price
30° Rating	20° Rating		Separate Closing Handles	Single Closing Handle	
<b>For Direct Current</b>					
12 1/2	12 1/2	26	371134	371224	\$120 00
25	25	26	371135	371225	120 00
50	50	26	371136	371226	138 00
75	75	26	371137	371227	138 00
100	100	26	371138	371228	149 00
150	150	26	371139	371229	170 00
200	200	26	371140	371230	184 00
300	250	42	371141	371231	208 00
400	350	48	371142	371232	246 00
600	500	70	371143	371233	377 00
800	650	86	371144	371234	423 00
1200	1000	127	371145	371235	620 00
1600	1200	154	371146	371236	705 00
2000	1600	179	371147	371237	815 00
3000	2500	321	371148	.....	1240 00
4000	3000	380	371149	.....	1620 00
<b>For Alternating Current‡</b>					
12 1/2	12 1/2	26	371514	371590	120 00
25	25	26	371515	371591	120 00
50	50	26	371516	371592	138 00
75	75	26	371517	371593	138 00
100	100	26	371518	371594	149 00
150	150	26	371519	371595	170 00
200	200	26	371520	371596	184 00
300	250	42	371521	371597	208 00
400	350	48	371522	371598	246 00
600	500	70	371523	371599	377 77
800	650	86	371524	371600	423 00
1000	800	127	371525	371601	620 00
1200	1000	154	371526	371602	705 00
1600	1200	179	371527	371603	815 00
2400	2000	321	371528	.....	1240 00
3000	2500	380	371529	.....	1620 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d.-c., 30-degree rating. Above that capacity standard breakers are supplied with top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

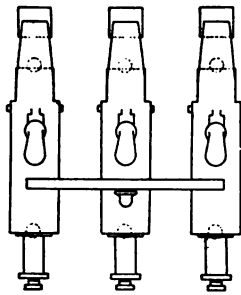
\*The breakers can be used for 600 volts if barriers are added. See additional list price for barriers under "Auxiliaries."

†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

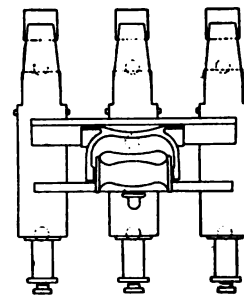
‡Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25 cycles up to and including the 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800 amperes refer to pages preceding the tables of ratings.

Order by Style Number

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



THREE-POLE  
REAR-CONNECTED  
THREE-COIL  
PLAIN OVERLOAD



For 250\* Volts Maximum

MAX. AMPS.†		Approximate Shipping Weight, Lbs.	STYLE No.	Single Closing Handle	List Price
30° Rating	20° Rating				
<b>For Direct Current</b>					
12½	12½	30	371172	371252	\$142 00
25	25	30	371173	371253	142 00
50	50	30	371174	371254	162 00
75	75	30	371175	371255	162 00
100	100	30	371176	371256	178 00
150	150	30	371177	371257	201 00
200	200	30	371178	371258	219 00
300	250	48	371179	371259	247 00
400	300	54	371180	371260	292 00
600	500	96	371181	371261	445 00
800	650	114	371182	371262	494 00
1200	1000	150	371183	371263	720 00
1600	1200	177	371184	371264	810 00
2000	1600	201	371185	371265	930 00
3000	2500	333	371186	.....	1350 00
4000	3000	393	371187	.....	1750 00

For Alternating Current‡

12½	12½	30	371552	371618	142 00
25	25	30	371553	371619	142 00
50	50	30	371554	371620	162 00
75	75	30	371555	371621	162 00
100	100	30	371556	371622	178 00
150	150	30	371557	371623	201 00
200	200	30	371558	371624	219 00
300	250	48	371559	371625	247 00
400	350	54	371560	371626	292 00
600	500	96	371561	371627	445 00
800	650	114	371562	371628	494 00
1000	800	150	371563	371629	720 00
1200	1000	177	371564	371630	810 00
1600	1200	201	371565	371631	930 00
2400	2000	333	371566	.....	1350 00
3000	2500	393	371567	.....	1750 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

\*The breakers can be used on 600 volts if barriers are added. See additional list prices for barriers under "Auxiliaries."

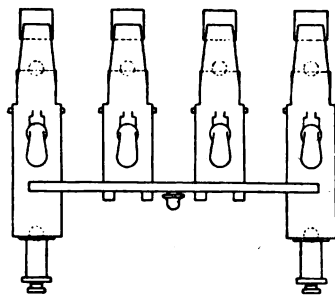
†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

‡Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25 cycles up to and including the 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800 amperes refer to pages preceding the tables of ratings.

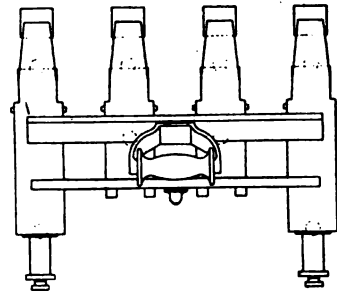
Order by Style Number



TYPE CL CARBON CIRCUIT-BREAKERS—Continued



**FOUR-POLE  
REAR-CONNECTED  
TWO-COIL  
PLAIN OVERLOAD**



**For 250\* Volts  
Maximum**

MAX. AMPS.†		Approximate Shipping Weight, Lbs.	STYLE No.		List Price
30° Rating	20° Rating		Separate Closing Handles	Single Closing Handle	
<b>For Direct Current</b>					
12½	12½	32	371289	371326	\$184 00
25	25	32	371290	371327	184 00
50	50	32	371291	371328	212 00
75	75	32	371292	371329	212 00
100	100	32	371293	371330	224 00
150	150	32	371294	371331	248 00
200	200	32	371295	371332	274 00
300	250	52	371296	371333	320 00
400	350	60	371297	371334	370 00
600	500	76	371298	371335	488 00
800	650	96	371299	371336	565 00
1200	1000	154	371300	371337	775 00
1600	1200	190	371301	371338	1000 00
2000	1600	224	371302	371339	1260 00

**For Alternating Current‡**

12½	12½	32	371846	371874	184 00
25	25	32	371847	371875	184 00
50	50	32	371848	371876	212 00
75	75	32	371849	371877	212 00
100	100	32	371850	371878	224 00
150	150	32	371851	371879	248 00
200	200	32	371852	371880	274 00
300	250	52	371853	371881	320 00
400	350	60	371854	371882	370 00
600	500	76	371855	371883	488 00
800	650	96	371856	371884	565 00
1000	800	154	371857	371885	775 00
1200	1000	190	371858	371886	1000 00
1600	1200	224	371859	371887	1260 00

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d.-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in the style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor-Bus-Supports."

**Sufficient nuts** per stud to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, shunt trip or reverse-current attachments, signal contacts and electric operating mechanism for use with the above breakers refer to the pages following those listing the breakers.

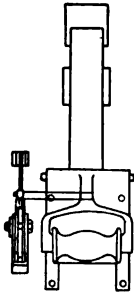
\*The breakers can be used on 600 volts if barriers are added. See additional list prices for barriers under "Auxiliaries."

†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

‡Alternating-current ratings specified above are for 60-cycle service. The same ratings apply for 25-cycles up to and including the 800-ampere, 30-degree rating breakers. For the corresponding 25-cycle ratings above 800-amperes refer to pages preceding the tables of ratings.

*Order by Style Number*

TYPE CL CARBON CIRCUIT-BREAKERS—Continued



**SINGLE AND TWO-POLE  
WITH FIELD-DISCHARGE CONTACTS  
HAND AND ELECTRICALLY-OPERATED  
SHUNT TRIP  
For 250 or 600\* Volts Maximum**

MAX. AMPS.		Approximate Shipping Weight, Lbs.	Style Number	List Price
30° Rating	20° Rating			
<b>Single-Pole Hand-Operated</b>				
300	300	24	371821	\$124 00
400	350	27	371822	136 00
600	500	48	371823	165 00
800	650	57	371824	184 00
1200	1000	75	371825	237 00
1600	1200	90	371826	280 00
2000	1600	100	371827	348 00
<b>Two-Pole Hand-Operated</b>				
300	300	40	371828	206 00
400	350	45	371829	231 00
600	500	80	371830	289 00
800	650	95	371831	328 00
1200	1000	125	371832	423 00
1600	1200	150	371833	545 00
2000	1600	167	371834	675 00
<b>Single-Pole Electrically-Operated</b>				
300	300	48	371835	259 00
400	350	61	371836	271 00
600	500	72	371837	300 00
800	650	81	371838	319 00
1200	1000	115	371839	380 00
1600	1200	120	371840	423 00
2000	1600	130	371841	489 00
<b>Two-Pole Electrically-Operated</b>				
300	300	70	371842	434 00
400	350	75	371843	459 00
600	500	110	371844	515 00
800	650	125	371845	655 00
1200	1000	165	371846	665 00
1600	1200	190	371847	785 00
2000	1600	207	371848	915 00

**Style number and list price**, in the case of the hand-operated breaker include the breaker without overload coil but with shunt trip, shunt-trip cutout, and field-discharge contact. In the case of the electrically operated breaker, a closing magnet with necessary links is also included in addition to the above attachments.

**Bases**—Style number and list price include the breaker mounted on wood or slate template. When specified on the order standard size black marine slate bases will be supplied at no additional charge.

**Studs**—Breakers are supplied with round studs up to and including 1200 amperes, d-c., 30-degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in the style number and list price on one stud per pole for 1200 amperes and below. For additional information refer to section on "Switchboard Details and Indoor Bus-Supports."

**Sufficient nuts per stud** to clamp the switch and to make connections to carry the rated current are included in style number and list price of round-stud breakers but not of laminated-stud breakers.

**Frankel Connectors** can be furnished with these breakers. For description and prices see section on "Westinghouse-Frankel Solderless Connectors."

**Attachments**—For inverse-time-limit, undervoltage-release, or reverse-current attachments, and signal contacts for use with the above breakers refer to the pages following those listing the breakers.

\*The single-pole breakers are for use on 250 or 600 volts. The two-pole breakers are for 250 volts maximum but they may be used for 600 volts if barriers are added. Additional list price for barriers is given under "Auxiliaries."

†Standard breakers are supplied with a calibration range of 80 to 160% of the 30-degree rating.

*Order by Style Number*

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

ELECTRICALLY OPERATED TYPE CL CARBON CIRCUIT-BREAKERS

The electrically operated type CL carbon circuit-breakers have a total list price equal to the list price of the corresponding manually operated breaker, plus the list price of the proper electric operating mechanism indicated below. The list prices specified include closing and tripping magnets complete with

closing and tripping coils. These list prices are not for these parts when sold alone but are merely an additional price covering these parts when they are included with hand-operated breakers to make electrically operated breakers.

ELECTRIC MECHANISM

Direct Current 30° Rating	AMPERE CAPACITY OF BREAKERS		List Price
	25-cycle	60-cycle	
<b>Single-Pole Breakers</b>			
12½ to 200	12½ to 200	12½ to 200	\$120 00
300 to 800	300 to 800	300 to 800	135 00
1200 to 2000	1200 to 1800	1000 to 1600	143 00
3000 to 4000	2750 to 3500	2400 to 3000	215 00
<b>Two-Pole Breakers</b>			
12½ to 200	12½ to 200	12½ to 200	300 00
300 to 800	300 to 800	300 to 800	228 00
1200 to 2000	1200 to 1800	1000 to 1600	241 00
3000 to 4000	2750 to 3500	2400 to 3000	385 00
<b>Three-Pole Breakers</b>			
12½ to 200	12½ to 200	12½ to 200	200 00
300 to 800	300 to 800	300 to 800	228 00
1200 to 2000	1200 to 1800	1000 to 1600	241 00
3000 to 4000	2750 to 3500	2400 to 3000	385 00

The list price of the mechanism for multi-pole breakers is on the basis of either separate electric mechanisms for each pole with common trip or on the basis of single or common electric mechanism for all poles.

ACCESSORIES FOR TYPE CL CARBON CIRCUIT-BREAKERS

The list prices given for the following accessories cover the accessory shipped with the breaker or separate from the breaker.

SHUNT TRIP ATTACHMENT

Style number does not include the coil or the cutout which must be specified on the order by style numbers from the tables below. The list price includes the mechanism complete with the coil but without the cutout which is priced below.



Ampere Capacity	APPROXIMATE WEIGHT, LBS.		Style Number	List Price
	Net	Shipping		
12½ to 800	6	8	323370	\$20 00
1200 to 6000	8	12	371702	25 00

COILS FOR SHUNT-TRIP ATTACHMENT

Ampere Capacity D-C.	Volts D-C.	APPROX. WEIGHT, LBS.		Style Number
		Net	Shipping	
12½ to 400	110	1½	2½	371733
12½ to 400	220	1½	2½	371734
12½ to 400	440 and 550	1½	2½	371735
12½ to 400	600	1½	2½	371738
600 to 800	110 and 125	1½	2½	371737
600 to 800	220 and 250	1½	2½	371738
600 to 800	440 and 550	1½	2½	371739
600 to 800	600	1½	2½	371740
1200 to 2000	110 and 125	1½	2½	371741
1200 to 2000	220 and 250	1½	2½	371742
1200 to 2000	440 and 500	1½	2½	371743
1200 to 2000	600	1½	2½	371744
3000 to 6000	110 and 125	1½	4	371745
3000 to 6000	220 and 250	2½	4	371746
3000 to 6000	440 and 500	2½	4	371747
3000 to 6000	600	2½	4	371748

UNDERVOLTAGE-RELEASE ATTACHMENT

Style number includes mechanism complete without coil. List price includes mechanism complete with coil which must be specified from the table below.



Ampere Capacity D-C.	APPROX. WEIGHT, LBS.		Style No. for A-C. Control	Style No. for D-C. Control	List Price
	Net	Shipping			
12½ to 400	5	7	323372*	323371*	\$20 00
300 to 400	5	7	†	371819†	.....
600 to 800	5	7	371710*	371704*	20 00
600 to 800	5	7	†	371820†	.....
1200 to 2000	9	11	371711‡	371705‡	20 00
3000 and 4000	9	11	371712‡	371706‡	25 00

\*These attachments are hand reset and can be used on hand-operated breakers only.

†These attachments are self-retrieving for electrically operated breakers.

‡Undervoltage-release attachments for a-c. control of electrically operated breakers are special. Information will be furnished on request.

§These attachments are self-retrieving but are for use with hand-operated breakers only. Attachments for a-c. control of electrically operated breakers are special. Information on request.

¶These attachments are self-retrieving and can be used for either hand or electrically operated breakers.

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

COILS FOR UNDERVOLTAGE-RELEASE ATTACHMENTS

Ampere Capacity D-C.	Volts D-C.	APPROX. WEIGHT, LBS.		STYLE NUMBER		
		Net	Shipping	D-C.	25 Cycles	60 Cycles
12 1/2 to 400	110 and 125	1 1/2	2 1/2	371753	371758	371778
12 1/2 to 400	220 and 250	1 1/2	2 1/2		371763	371782
12 1/2 to 400	440 and 500	1 1/2	2 1/2	371754	371768	371788
12 1/2 to 400	600	1 1/2	2 1/2		371773	371793
600 to 800	110 and 125	1 1/2	2 1/2	371754	371759	371779
600 to 800	220 and 250	1 1/2	2 1/2		371764	371784
600 to 800	440 and 500	1 1/2	2 1/2	371755	371769	371789
600 to 800	600	1 1/2	2 1/2		371774	371794
1200 to 4000	110 and 125	1 1/2	2 1/2	371755	371760	371780
1200 to 4000	220 and 250	1 1/2	2 1/2		371765	371785
1200 to 4000	440 and 500	1 1/2	2 1/2	371755	371770	371790
1200 to 4000	600	1 1/2	2 1/2		371775	371795

INVERSE-TIME-LIMIT ATTACHMENT

The following table gives the additional list price per pole to add for the addition of the dash-pot time-limit device.

Ampere Capacity D-C. Rating	APPROX. WEIGHT, LBS.		List Price
	Net	Boxed	
12 1/2 to 200	4	6	\$20 00
300 and 400	4	6	30 00
600 to 800	4	6	40 00
1200 to 2000	4	6	40 00
3000 and 4000	8	12	50 00

REVERSE-CURRENT TRIP ATTACHMENT

Style number includes mechanism complete without coils. List price includes mechanism complete with coils which should be specified from table below.



Amp. Capacity D-C. Rating	APPROX. WEIGHT, LBS.		Style No.	List Price
	Net	Boxed		
12 1/2 to 200 A.	4	5	371715*	\$33 00
300	4	5	371716*	35 00
600	4	6	371717*	40 00
800	4	6	371718*	40 00
1200	6	10	371719	50 00
1600	6	10	371720	50 00
2000	10	16	371721	80 00
3000	10	16	371722	70 00
4000	10	16	371723	80 00

\*These attachments are hand-reset and therefore can be applied to hand-operated breakers only. Information will be supplied on request regarding reverse current mechanisms for electrically operated breakers. All other mechanisms listed are self-retrieving and can be used for hand or electrically operated breakers.

COILS FOR REVERSE-CURRENT TRIP ATTACHMENT

The coils listed below are for use with reverse-current trip attachments listed above and must be ordered separately.

Ampere Capacity D-C. Rating	Volts D-C.	APPROX. WEIGHT, LBS.		Style No.
		Net	Boxed	
12 1/2 to 200	110 and 125	1 1/2	2 1/2	371798
12 1/2 to 200	220 and 250	1 1/2	2 1/2	371805
12 1/2 to 200	600	1 1/2	2 1/2	371812
300 and 400	110 and 125	1 1/2	2 1/2	371799
300 and 400	220 and 250	1 1/2	2 1/2	371806
300 and 400	600	1 1/2	2 1/2	371813
600 and 800	110 and 125	1 1/2	2 1/2	371800
600 and 800	220 and 250	1 1/2	2 1/2	371807
600 and 800	600	1 1/2	2 1/2	371814
1200 and 2000	110 and 125	1 1/2	2 1/2	371801
1200 and 2000	220 and 250	1 1/2	2 1/2	371808
1200 and 2000	600	1 1/2	2 1/2	371815
3000 and 4000	110 and 125	2 1/2	4	371802
3000 and 4000	220 and 250	2 1/2	4	371809
3000 and 4000	600	2 1/2	4	371816

BARRIERS WITH BRACKETS

Style number and list price include single brackets complete with barriers for mounting on panel and are made of black marine slate.

Ampere Capacity	Style No.	List Price
12 1/2 to 200	371728	\$11 00
300 and 400	371729	11 00
600 and 800	371730	11 00
1200 to 2000	371731	14 00
3000 to 4000	371732	14 00

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

DIMENSIONS IN INCHES  
SINGLE-POLE

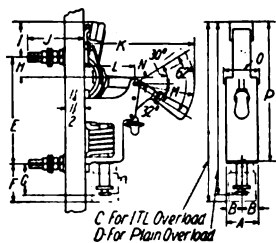


FIG. 1—12 1/2 to 800 AMPERES

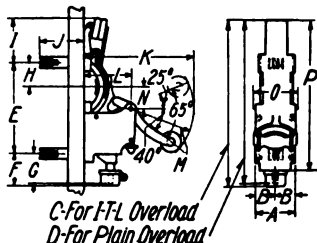


FIG. 2—1200 TO 2000 AMPERES

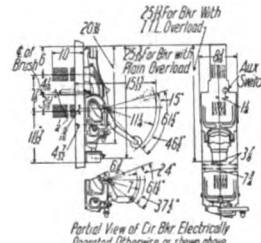


FIG. 3—3000 TO 6000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES															
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
12 1/2-100	1	2 1/4	1 1/2	14 3/8	14 1/2	8 3/8	3 3/8	3	1 5/8	2 3/8	3	7 3/8	3 3/8	4 1/2	1 1/2	2 1/2	11 1/8
150-200	1	2 1/4	1 1/2	14 3/8	14 1/2	8 3/8	3 3/8	3	1 5/8	2 3/8	3 1/4	7 3/8	3 3/8	4 1/2	1 1/2	2 1/2	11 1/8
300	1	2 1/4	1 1/2	15 1/8	14 1/2	9 1/8	3 3/8	2 3/8	1 3/4	2 3/8	3 3/8	9 3/8	4 3/8	5 3/8	3 3/8	3 3/8	12 1/8
400	1	2 1/4	1 1/2	15 1/8	14 1/2	9 1/8	3 3/8	2 3/8	1 3/4	2 3/8	4 1/2	9 3/8	4 3/8	5 3/8	3 3/8	3 3/8	12 1/8
600*	1	3 1/4	1 1/2	18 3/8	18 3/8	10 1/2	3 3/8	3 3/8	2 3/8	3 3/8	5	11 1/2	5 1/2	6	3 3/8	3 3/8	12 1/2
800*	1	3 1/4	1 1/2	18 3/8	18 3/8	10 1/2	3 3/8	3 3/8	2 3/8	3 3/8	5 1/2	11 1/2	5 1/2	6	3 3/8	3 3/8	12 1/2
1200†	2	5	2 1/2	19 3/8	20 1/2	11 3/8	3 3/8	4 1/2	2 3/8	4 3/8	5 1/2	13 3/8	5 3/8	7 3/8	2 3/8	5 3/8	16 1/8
1600	2	5	2 1/2	19 3/8	19 1/2	11 3/8	3 3/8	3 3/8	2 3/8	4 3/8	5 1/2	13 3/8	5 3/8	7 3/8	2 3/8	5 3/8	16 1/8
2000	2	5	2 1/2	19 3/8	19 1/2	11 3/8	3 3/8	3 3/8	2 3/8	4 3/8	5 1/2	13 3/8	5 3/8	7 3/8	2 3/8	5 3/8	16 1/8

TWO-POLE  
Single-Coil

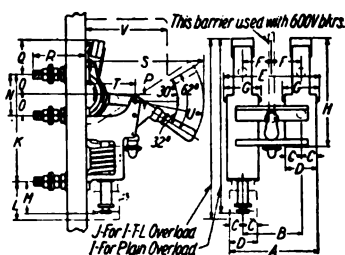


FIG. 4—12 1/2 TO 800 AMPERES

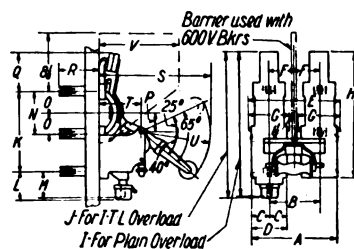


FIG. 5—1200 TO 2000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
12 1/2-100	4	6 3/4	4 1/2	1 1/2	2 1/4	7 1/2	2 1/4	2 3/8	9 3/8	14 1/2	14 3/8	8 3/8	3 3/8	3	3 3/8	1 3/8	1	2 3/8	3	8 3/4	3 3/8	4 3/8	6
150-200	4	6 3/4	4 1/2	1 1/2	2 1/4	7 1/2	2 1/4	2 3/8	9 3/8	14 1/2	14 3/8	8 3/8	3 3/8	3	3 3/8	1 3/8	1	2 3/8	3 1/4	8 3/4	3 3/8	4 3/8	6
300	4	7 3/4	5	1 3/8	2 3/4	8 1/2	2 3/8	3 3/8	9 3/8	14 1/2	15 1/8	9 1/8	3 3/8	2 3/8	3 3/8	1 3/8	1 3/8	2 3/8	3 3/4	10 1/2	4 3/8	5 3/8	7
400	4	7 3/4	5	1 3/8	2 3/4	8 1/2	2 3/8	3 3/8	9 3/8	14 1/2	15 1/8	9 1/8	3 3/8	2 3/8	3 3/8	1 3/8	1 3/8	2 3/8	4 1/2	10 1/2	4 3/8	5 3/8	7
600*	4	9 1/4	6	1 3/8	3 1/4	9 3/4	3	3 3/8	12 1/2	18 3/8	18 3/8	10 1/2	3 3/8	3 3/8	4 3/8	2 3/8	2 3/8	3 3/8	5	12 3/8	5 1/2	6 3/8	8 3/8
800*	4	9 1/4	6	1 3/8	3 1/4	9 3/4	3	3 3/8	12 1/2	18 3/8	18 3/8	10 1/2	3 3/8	3 3/8	4 3/8	2 3/8	2 3/8	3 3/8	5 1/2	12 3/8	5 1/2	6 3/8	8 3/8
1200†	5	12	7	2 1/2	5	12 1/2	3 3/8	5 1/2	17 1/2	20 1/2	19 3/8	11 3/8	3 3/8	4 1/2	5 1/2	2 3/8	2 3/8	4 3/8	5 1/2	15 1/2	5 3/8	9 3/4	11
1600	5	12	7	2 1/2	5	12 1/2	3 3/8	5 1/2	17 1/2	19 3/8	19 3/8	11 3/8	3 3/8	4 1/2	5 1/2	2 3/8	2 3/8	4 3/8	5 1/2	15 1/2	5 3/8	9 3/4	11
2000	5	12	7	2 1/2	5	12 1/2	3 3/8	5 1/2	17 1/2	19 3/8	19 3/8	11 3/8	3 3/8	4 1/2	5 1/2	2 3/8	2 3/8	4 3/8	5 1/2	15 1/2	5 3/8	9 3/4	11
3000‡	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4000‡	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

\*The set-screw knob of the inverse-time-limit overload attachment for the 600 and 800-ampere breakers extends 3/4 inches beyond the side of the breaker.

†The 1200-ampere breaker is furnished with round studs. See page 145 for dimensions.

‡Common closing handle is not used on breakers for above 2000 amperes. For 3000 and 4000-ampere breakers two single-pole breakers the same as Fig. 3, of this page, are used, with common trip-bar and the distance between pole-unit centerlines is 10 inches. For terminal dimensions see page 145.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

TWO-POLE

Two-Coil

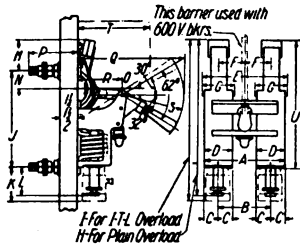


FIG. 1—12 1/2 to 800 AMPERES

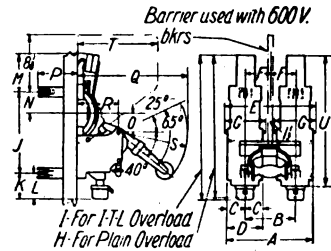


FIG. 2—1200 to 2000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES																				
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
12 1/2-100	1	6 3/4	4 1/2	1 1/2	2 1/4	7 1/2	2 1/4	2 3/8	14 1/2	14 3/8	8 3/8	3 3/8	3	2 3/8	1 5/8	1 1/2	3	8 3/8	3 3/8	4 3/8	6	11 1/2
150-200	1	6 3/4	4 1/2	1 1/2	2 1/4	7 1/2	2 1/4	2 3/8	14 1/2	14 3/8	8 3/8	3 3/8	3	2 3/8	1 5/8	1 1/2	3 1/4	8 3/8	3 3/8	4 3/8	6	11 1/2
300	1	7 3/4	5	1 3/8	2 3/4	8 1/2	2 1/2	3 1/8	14 7/8	15 1/4	9 1/8	3 3/8	2 3/8	2 3/8	1 3/4	3 3/8	10 1/8	4 3/8	5 3/8	7	12 1/2	
400	1	7 3/4	5	1 3/8	2 3/4	8 1/2	2 1/2	3 1/8	14 7/8	15 1/4	9 1/8	3 3/8	2 3/8	2 3/8	1 3/4	4 1/8	10 1/8	4 3/8	5 3/8	7	12 1/2	
600*	1	9 1/4	6	1 5/8	3 1/4	9 3/8	3	3 3/8	18 3/8	18 3/8	10 7/8	3 3/8	3 1/8	3 3/8	2 3/8	5	12 3/8	5 1/8	6 3/8	8 1/2	12 1/2	
800*	1	9 1/4	6	1 5/8	3 1/4	9 3/8	3	3 3/8	18 3/8	18 3/8	10 7/8	3 3/8	3 1/8	3 3/8	2 3/8	5 1/4	12 3/8	5 1/8	6 3/8	8 1/2	12 1/2	
1200†	2	12	7	2 1/2	5	12 1/2	3 1/2	5 1/2	20 1/2	19 3/4	11 1/2	3 3/8	4 1/4	4 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	9 3/4	11	16 1/2
1600	2	12	7	2 1/2	5	12 1/2	3 1/2	5 1/2	19 1/2	19 3/4	11 1/2	3 3/8	3 3/8	4 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	9 3/4	11	16 1/2
2000	2	12	7	2 1/2	5	12 1/2	3 1/2	5 1/2	19 1/2	19 3/4	11 1/2	3 3/8	3 3/8	4 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	9 3/4	11	16 1/2
3000†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
4000†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

THREE-POLE

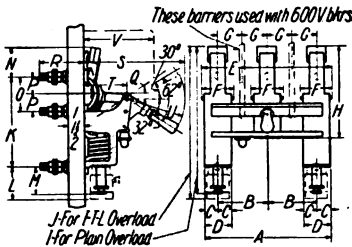


FIG. 3—12 1/2 to 800 AMPERES

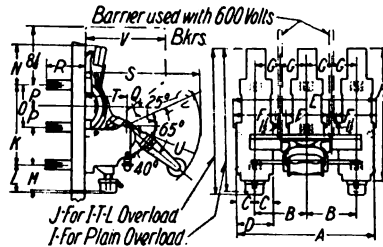


FIG. 4—1200 to 2000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES																					
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
12 1/2-100	3	11 1/4	4 1/2	1 1/2	2 1/4	11 3/4	2 3/8	2 1/4	11 1/2	14 1/2	14 3/8	8 3/8	3 3/8	3	2 3/8	3 3/8	1 5/8	1 1/2	3	8 3/8	3 3/8	4 3/8	6
150-200	3	11 1/4	4 1/2	1 1/2	2 1/4	11 3/4	2 3/8	2 1/4	11 1/2	14 1/2	14 3/8	8 3/8	3 3/8	3	2 3/8	3 3/8	1 5/8	1 1/2	3 1/4	8 3/8	3 3/8	4 3/8	6
300	3	12 3/4	5	1 3/8	2 3/4	13 1/2	3 1/8	3 1/4	12 1/2	14 3/8	15 1/4	9 1/8	3 3/8	2 3/8	2 3/8	3 3/8	1 3/4	3 3/8	10 1/8	4 3/8	5 3/8	7	
400	3	12 3/4	5	1 3/8	2 3/4	13 1/2	3 1/8	3 1/4	12 1/2	14 3/8	15 1/4	9 1/8	3 3/8	2 3/8	2 3/8	3 3/8	1 3/4	3 3/8	10 1/8	4 3/8	5 3/8	7	
600*	3	15 1/4	6	1 5/8	3 1/4	15 3/8	3 3/8	3	12 1/2	18 3/8	18 3/8	10 7/8	3 3/8	3 3/8	3 3/8	4 3/8	2 3/8	5	14 1/8	5 3/8	9	8 1/2	
800*	3	15 1/4	6	1 5/8	3 1/4	15 3/8	3 3/8	3	12 1/2	18 3/8	18 3/8	10 7/8	3 3/8	3 3/8	3 3/8	4 3/8	2 3/8	5 1/4	14 1/8	5 3/8	9	8 1/2	
1200†	4	19	7	2 1/2	5	19 1/2	5 1/2	3 1/2	16 1/2	20 1/2	19 3/4	11 1/2	3 3/8	4 1/4	4 3/8	5 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	10 1/2	
1600	4	19	7	2 1/2	5	19 1/2	5 1/2	3 1/2	16 1/2	19 1/2	19 3/4	11 1/2	3 3/8	3 3/8	4 3/8	5 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	10 1/2	
2000	4	19	7	2 1/2	5	19 1/2	5 1/2	3 1/2	16 1/2	19 1/2	19 3/4	11 1/2	3 3/8	3 3/8	4 3/8	5 3/8	2 3/8	2 3/8	5 1/4	15 3/8	5 3/8	10 1/2	
3000†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
4000†	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	

\*The set-screw knob of the inverse-time-limit overload attachment for the 600 and 800-ampere breakers extends 3/4 inches beyond the side of the breaker.  
 †The 1200-ampere breaker is furnished with round studs. See page 145 for dimensions.  
 ‡Common closing handle is not used on breakers for above 2000 amperes. 3000 and 4000-ampere, two and three-pole breakers are made up, respectively, from two and three single-pole breakers the same as Fig. 3, page 143, with common trip-bar, and the distance between pole-unit centerlines is 10 inches.  
 For terminal dimensions see page 145.  
 These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

FOUR-POLE

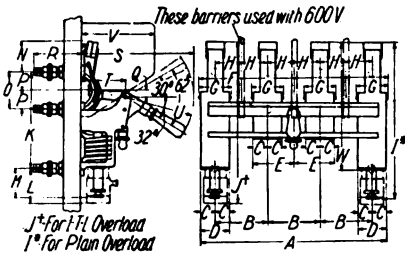


Fig. 1—12 1/2 to 800 AMPERES

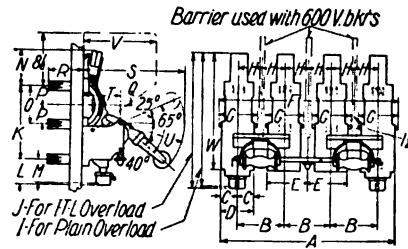


Fig. 2—1200 to 2000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES																						
		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
12 1/2-100	1	15 3/4	4 1/2	1 1/2	2 1/4	2 1/4	16 1/2	2 1/2	2 1/4	14 1/2	14 1/2	8 3/4	3 1/2	3	2 1/2	3 3/4	1 1/2	1 1/2	3	9 1/2	3 1/2	5 3/4	6	11 1/2
150-200	1	15 3/4	4 1/2	1 1/2	2 1/4	2 1/4	16 1/2	2 1/2	2 1/4	14 1/2	14 1/2	8 3/4	3 1/2	3	2 1/2	3 3/4	1 1/2	1 1/2	3 1/4	9 1/2	3 1/2	5 3/4	6	11 1/2
300	1	17 1/4	5	1 3/4	2 3/4	2 1/2	18 1/2	3 1/2	2 1/2	14 1/2	15 1/2	9 1/2	3 1/2	2 1/2	2 1/2	3 1/2	1 1/2	1 1/2	3 3/4	10 1/2	4 1/2	6 3/4	7	12 1/2
400	1	17 1/4	5	1 3/4	2 3/4	2 1/2	18 1/2	3 1/2	2 1/2	14 1/2	15 1/2	9 1/2	3 1/2	2 1/2	2 1/2	3 1/2	1 1/2	1 1/2	4 1/2	10 1/2	4 1/2	6 3/4	7	12 1/2
600*	1	21 1/4	6	1 3/4	3 1/4	3	21 1/2	3 3/4	3	18 1/2	18 1/2	10 1/2	3 3/4	3 3/4	3 3/4	4 1/2	2 1/2	2 1/2	5	14	5 1/2	8 1/2	8 1/2	12 1/2
800*	1	21 1/4	6	1 3/4	3 1/4	3	21 1/2	3 3/4	3	18 1/2	18 1/2	10 1/2	3 3/4	3 3/4	3 3/4	4 1/2	2 1/2	2 1/2	5 1/4	14	5 1/2	8 1/2	8 1/2	12 1/2
1200†	2	26	7	2 1/4	5	3 1/2	26 1/2	5 1/2	6 1/4	20 1/2	19 1/2	11 1/2	3 3/4	4 1/2	4 1/2	5 1/2	2 1/2	2 1/2	5 1/2	15 1/2	5 1/2	9 3/4	11	16 1/2
1600	2	26	7	2 1/4	5	3 1/2	26 1/2	5 1/2	6 1/4	19 1/2	19 1/2	11 1/2	3 3/4	4 1/2	4 1/2	5 1/2	2 1/2	2 1/2	5 1/2	15 1/2	5 1/2	9 3/4	11	16 1/2
2000	2	26	7	2 1/4	5	3 1/2	26 1/2	5 1/2	6 1/4	19 1/2	19 1/2	11 1/2	3 3/4	4 1/2	4 1/2	5 1/2	2 1/2	2 1/2	5 1/2	15 1/2	5 1/2	9 3/4	11	16 1/2
3000‡	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
4000‡	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

\*The set-screw knob of the inverse-time-limit overload attachment for the 600 and 800-ampere breakers extends 1/4 inches beyond the side of the breaker.

†The 1200-ampere breaker is furnished with round studs. See page 145 for dimensions.  
‡Common closing handle is not used on breakers for above 2000 amperes. For 3000 and 4000-ampere breakers four single-pole breakers the same as Fig. 3, page 143, are used with common trip-bar, and the distance between pole-unit centerlines is 10 inches. For terminal dimensions see table below.

TERMINALS AND STUDS

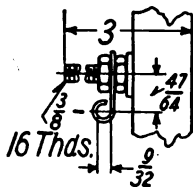


Fig. 3—12 1/2 to 50 AMPERES

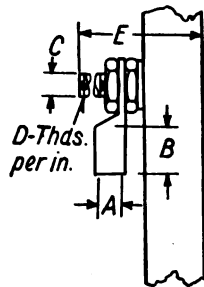


Fig. 4—75 to 1200 AMPERES

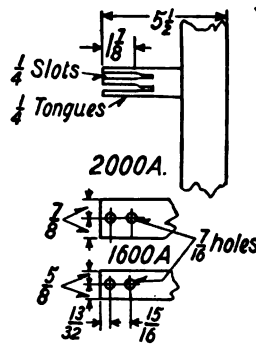


Fig. 5—1600 to 2000 AMPERES

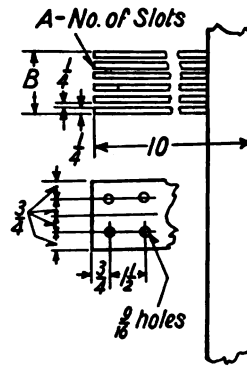


Fig. 6—3000 to 6000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES					Terminals per Stud
		A	B	C	D	E	
75-100	4	.384	3/8	3/4	16	3	1
150-200	4	.558	1/2	1 1/2	13	3 1/4	1
300	4	.918	1 1/8	2 1/2	11	3 3/4	1
400	4	.918	1 1/8	2 1/2	16	4 1/2	1
600	4	1.28	1 1/2	3 1/2	16	5	1
800	4	1 1/2	1 3/4	4	14	5 1/4	2
1200	4	1.28	1 3/4	4	14	5 3/4	2
3000	6	4	2 1/4	...	...	...	...
4000	6	5	2 3/4	...	...	...	...
6000	6	6	3 1/4	...	...	...	...

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE CL CARBON CIRCUIT-BREAKERS—Continued

SHUNT TRIP ATTACHMENT

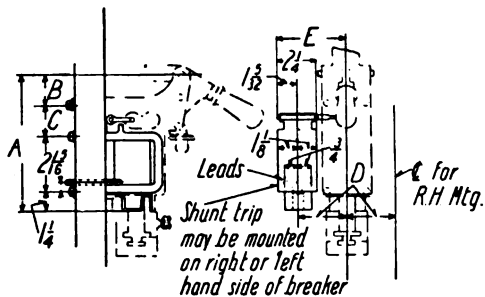


FIG. 1—12½ TO 800 AMPERES

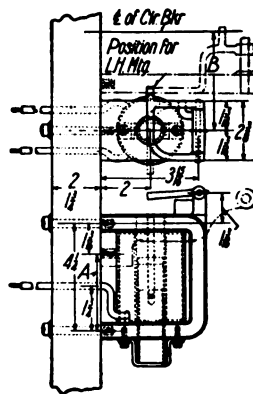


FIG. 2—1200 TO 6000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES					Amp.	Fig.	DIMENSIONS IN INCHES	
		A	B	C	D	E			A*	B
12½-200	1	6¾	¾	1¾	2¼	3¾	1200-2000	2	3¾	4¾
300-400	1	7¾	1¾	1¾	2¾	2¾	2500-4000	2	5½	5½
600-800	1	8¾	2¾	1¾	3	4¾	6000	2	5¾	5¾

\*A is the distance from the lower bolt-hole of the attachment to the lower side frame bolt-hole of the breaker.

UNDERVOLTAGE-RELEASE ATTACHMENT†

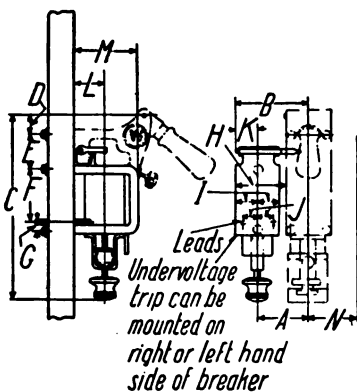


FIG. 3—12½ TO 800 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES													
		A	B	C	D	E	F	G	H	I	J	K	L	M	N
12½-200	3	2¼	3¾	9¼	¾	1¾	2¾	½	2¼	1¼	¾	1¼	1¼	3¼	2¼
300-400	3	2¾	3¾	9¾	1½	1¾	2¾	½	2¼	1¼	¾	1¼	1¼	3¼	2¼
600-800	3	4¼	5¾	13¾	2¾	2¾	2¾	1¾	2¼	1¾	1¼	1¾	2	4¾	3¾

†For dimensions of undervoltage release attachments for above 800 amperes refer to nearest district office. These dimensions are for reference only. For official dimensions refer to nearest district office.



THE CL CARBON CIRCUIT-BREAKERS—Continued  
REVERSE-CURRENT TRIP ATTACHMENT

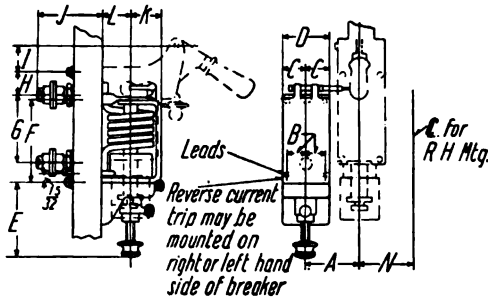


FIG. 1—12 1/2 TO 800 AMPERES

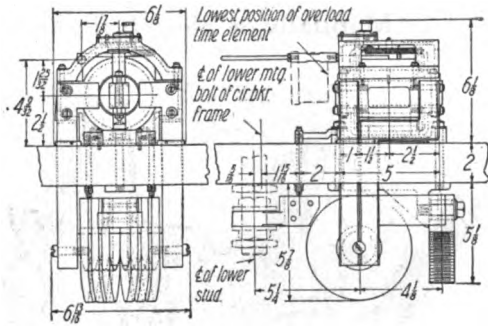


FIG. 1200 TO 6000 AMPERES

Amps.	Fig.	DIMENSIONS IN INCHES													
		A	B	C	D	E	F	G	H	I	J	K	L	N	
12 1/2-100	1	2 1/4	3/4	1 1/4	2 1/4	4 1/4	4 1/4	3 1/4	1 3/4	1 1/4	3	1 3/4	1 1/4	2 1/4*	
100-200	1	2 1/2	3/4	1 1/2	2 1/4	4 1/4	4 1/4	3 1/4	1 3/4	1 1/4	3 1/4	1 3/4	1 1/4	2 1/4*	
300	1	3 1/8	1 1/8	1 3/8	2 3/4	4 1/4	4 1/4	3 1/4	1 3/4	1 1/4	3 1/4	3 1/4	1 1/4	3 1/4	
400	1	3 1/8	1 1/8	1 3/8	2 3/4	4 1/4	4 1/4	3 1/4	1 3/4	1 1/4	4 1/4	3 1/4	1 1/4	3 1/4	
600	1	3 3/8	1 1/8	1 3/8	3 1/4	5 1/4	5 1/4	3 1/4	1 3/4	2 1/4	5	4 3/8	2 1/4	4 3/8	
800	1	3 3/4	1 1/8	1 3/8	3 1/4	5 1/4	5 3/8	3 1/4	1 3/4	2 1/4	5 1/4	4 3/8	2 1/4	4 3/8	

\*3 1/4 inches when used with inverse-time-limit overload breakers.

AUXILIARY SWITCH

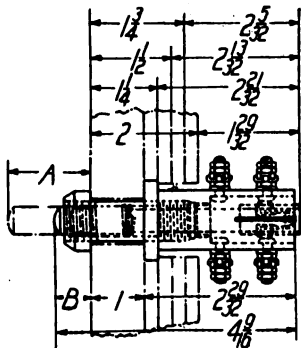


FIG. 3—SINGLE-POLE, DOUBLE-THROW

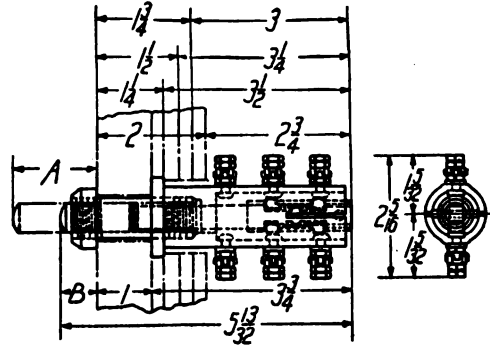


FIG. 4—TWO-POLE, DOUBLE-THROW

Amps.	Fig.	DIMENSIONS IN INCHES		Amps.	Fig.	DIMENSIONS IN INCHES	
		A	B			A	B
12 1/2-200	1 and 2	1 1/4	1 1/4	1200-2000	1 and 2	2 3/4	1 3/4
300-400	1 and 2	1 1/4	1 1/4	3000-4000	1 and 2	2 3/4	1 3/4
600-800	1 and 2	1 1/4	1	6000*	1 and 2	2 3/4	1 3/4

\*6000-ampere breakers are usually mounted on a 2 1/4-inch panel. These dimensions are for reference only. For official dimensions apply to nearest district office.

# TYPE CA CARBON CIRCUIT-BREAKERS

Manually or Electrically Operated—For D-C. or A-C. Circuits

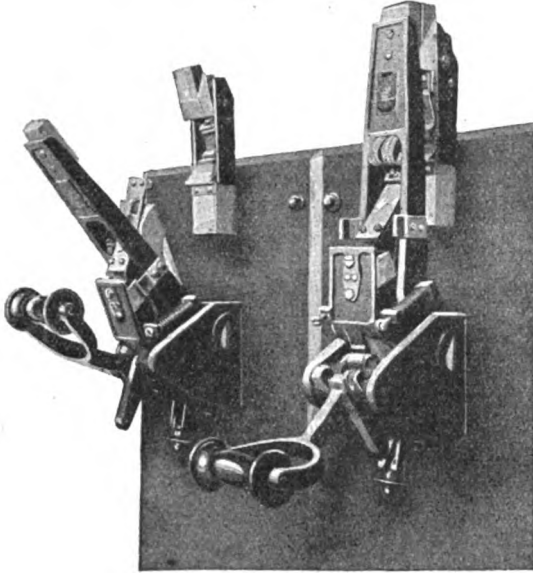


FIG. 1—MANUALLY OPERATED DIRECT-CONTROL SINGLE-POLE 2000-AMPERE, CIRCUIT BREAKER OPEN AND CLOSED POSITIONS

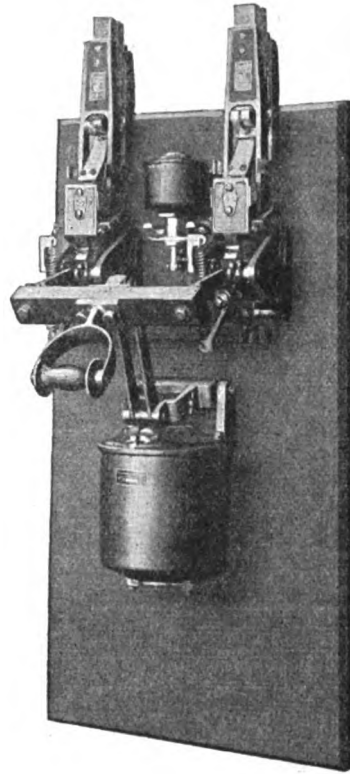


FIG. 2—TYPE CA FIELD DISCHARGE CIRCUIT-BREAKER—ELECTRICALLY OPERATED, 1000 TO 2500 AMPERES—CLOSING COIL ENERGIZED TO HOLD DOWN CORE AND HANDLE

## Application

Type CA carbon circuit-breakers are designed for the severe current-carrying and interrupting conditions found in operating low-voltage direct and alternating-current systems and particularly heavy duty railway systems with great power concentration. They are made in the following capacities, based on 30 degrees Centigrade rise:

FOR CIRCUIT	Frequency Cycles	Max. Volts	MAXIMUM AMPERES	
			Manually Operated Direct-Control	Manually Operated Remote-Electrically Control Operated
Direct	.....	{ 750 1500	24000	..... 24000
Alternating	{ 25	750	10000	..... 2500 8000
	{ 60	750	7000	..... 10000 7000

When conditions make it desirable to operate carbon circuit-breakers from a distance, the electrically operated form or the manually operated remote-control, within its limited application, is furnished.

## CONSTRUCTION

Type CA circuit-breakers are more compact, except in the overall length, than any other type of carbon circuit-breaker on the market, of equal conducting and interrupting capacity. The added length is due wholly to the longer break distance and greater length of carbon arm, which experience in heavy railway service has shown to be desirable.

The automatic-overload tripping attachment is contained in the circuit-breaker and forms an integral part of it.

The simple form of toggle mechanism used throughout is especially worthy of note. This

This makes it possible to install the circuit-breaker near the apparatus to be connected, the same as the equalizer connection of a direct-current generator, and to retain the control at the switchboard. Another common application of the electrically operated form is for remote-control feeder tie-switches on distributing systems. Such arrangements effect a saving in wiring, as a light control cable takes the place of the heavy power cable otherwise required.

toggle on all sizes, from 3,000 to 24,000 amperes, consists of but a single link member connecting the handle lever and main contact arm, but is so shaped and related to the lever members as to form an eccentric toggle of exceptional power. In the sizes below 3,000 amperes the toggle is of the roller type, formed by means of a roller on the inner end of the handle lever acting directly on a plane surface on the brush-arm or main-contact lever. Both forms are best adapted to their particular sizes of breaker and form the simplest mechanism known to be used for the purpose.

## TYPE CA CARBON CIRCUIT-BREAKERS—Continued

**Main Contacts**—In larger capacities, where the moving contact is subdivided in order to obtain a better average distribution of contact pressure, large ventilating spaces are provided between the individual laminated main-contact members—an exclusive feature of the type CA carbon circuit-breakers. This reduces the temperature rise very materially under any given conditions of load and increases the capacity on alternating-current service by reducing the skin effect. When the breaker is tripped, the main contacts are opened first and the current is shunted upward through copper secondary and tertiary contacts to the carbon arcing contacts where the break takes place. (See Fig. 3).

**Secondary Contacts**—Directly over the brush contacts the secondary contacts are located. The secondary stationary contact has a surface inclined to the vertical and practically parallel to the plane of support of the moving contact spring, thus preventing buckling of the spring in case the contact is roughened by repeated opening under short-circuit conditions. The moving contact spring is held under initial pressure until just before the contacts close. The secondary contacts open next after the main or brush contacts open, protecting the latter from arcing under severe short-circuit conditions.

An adjusting screw on the moving contact allows an adjustment of the relation of the opening of the main and secondary contacts.

**Tertiary Contacts**—The tertiary contacts are attached to the lower end of the carbon contacts of which they appear to be a part. They are made of

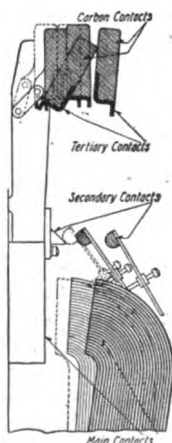


FIG. 3—WESTINGHOUSE TYPE CA CARBON CIRCUIT-BREAKER CONTACTS

This diagram shows the shape and relative position of each of the contacts in the three important stages of breaking the circuit as follows:

1. Contacts outlined by dotted lines show main brush opened, secondary contact on point of opening, and tertiary and carbon contacts not changed from closed position.
2. Contacts shown by light shading show main and secondary contacts open, tertiary and carbon contacts still closed, but one set of contacts has slid down on the other set.
3. Contacts shown by heavy shading show the tertiary contact open and carbon tips about to finally break the circuit.

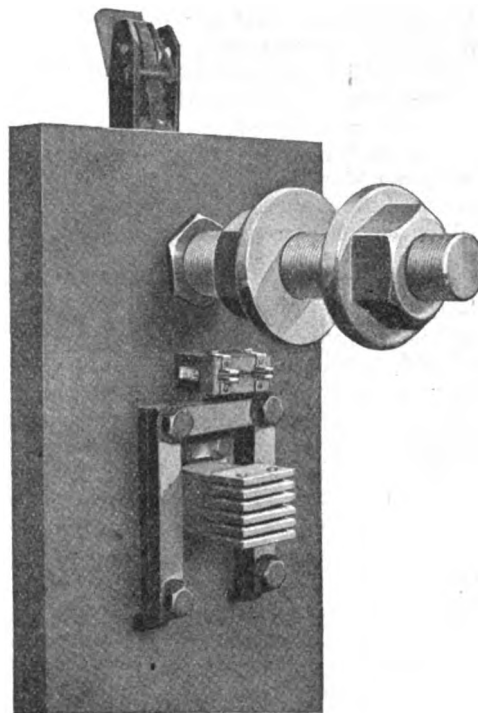


FIG. 4—SHOWING 4000-AMPERE MILL-SLOTTED STUD, ROUND STUD, AND SIGNAL SWITCH OF TYPE CA CIRCUIT-BREAKER

copper and are connected to the main or brush contacts by heavy copper shunts. They open immediately before the carbon contacts open and fully protect the secondary contacts except under extreme conditions of repeated short-circuit without proper maintenance.

**Carbon Contacts**—The carbon or final contacts are an intimate mixture of graphite and carbon having high tensile strength and low specific resistance, so as to carry the current an instant after the tertiary contact opens. They are self-aligning and have a self-wiping action, thus making them self-cleaning.

The carbon arms are of ample length and open far enough to insure breaking the heaviest arc incident to short-circuit, as in heavy railway service.

**Connections**—All standard type CA circuit-breakers are arranged for rear connection. The main contact blocks form part of the terminal studs.

These breakers can be supplied with Westinghouse-Frankel Solderless Connectors. For prices of these connectors see pages on Westinghouse-Frankel Connectors.

**Handles**—The manually operated direct-control type CA carbon circuit-breakers have an insulated spade-grip handle for capacities up to 6000 amperes direct-current.

Above 6000 amperes direct-current, detachable pole handles are provided.

## TYPE CA CARBON CIRCUIT-BREAKERS—Continued

**Contactor-Type**—A line of breakers known as the type CA "contactor-type" circuit-breaker (see Fig. 6) is available in capacities from 1000 amperes to 8000 amperes direct-current, inclusive, and in intermediate capacities corresponding to the regular type CA single-pole line. The term "contactor-type" means a breaker that is electrically-operated, but held in the closed position by the presence of a small amount of closing current on the operating magnet and not by a mechanical latch, as is usual with the standard manually or electrically-operated type CA breakers. The breaker drops to the open position on the absence of voltage in the control circuit. The contactor type of electrically-operated breaker is much simpler than the standard electrically-operated form, which has all of the parts of the regular manually-operated breaker and the electric operating mechanism in addition. However, they are made only in the single-pole non-automatic form, which accounts in part for the simplicity.

The contactor breaker is made automatic by the addition of overload or reverse-power relays arranged to open the closing-coil circuit or to short-circuit the closing coil with resistance in series. The latter relay scheme permits the use of standard contact-closing relays.

The contactor breaker is adapted for use as an automatic feeder tie-switch in conjunction with appropriate relays and connections. In this service it is adjusted to open when the voltage drops below a certain predetermined limit, as would be caused by an excessive overload or short-circuit in the vicinity. The breaker will then remain open until some prede-

termined voltage exists on both feeders that it is arranged to tie, and then automatically close.

Multipole contactor breakers are made by using several single-pole units controlled by a single control switch or relay, or both.

**Field Discharge Breakers**—A combined shunt-trip and field-discharge contact is available on all capacities up to 2500 amperes direct-current for either manual or electrical operation.

**Manually-Operated Remote-Control Breakers**—For service up to 1500 volts direct-current and capacities up to 2500 amperes, single-pole type CA manually-operated breakers are supplied for mounting away from the switchboard panels, but operated from a handle mounted on the panel in the usual location for the knife switch.

**Multipole Circuit-Breakers**—Each multipole breaker is provided with a common trip; that is, an overload on any one pole trips all poles. The manually-operated breakers (two, three or four-pole), up to and including 2500 amperes capacity, can be provided with a single closing-handle and cross-bar for closing all poles together (all poles tripped together). This form of handle is arranged, by springs, to retrieve independently of the breaker pole units so as not to retard the operation of the breaker on opening. However, for 4-wire 2-phase work, we recommend closing one leg of each phase by means of a 2-pole handle and then closing the other legs of each phase by another 2-pole handle. All poles should be arranged to trip together.

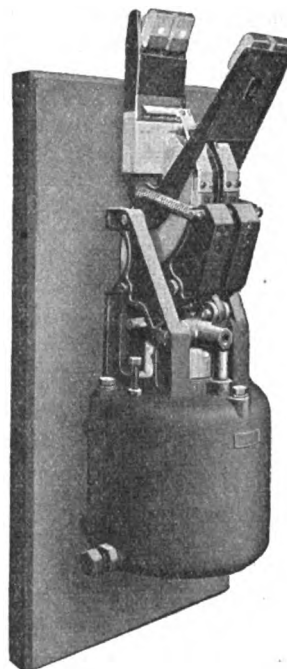


FIG. 6—CONTACTOR-TYPE, ELECTRICALLY-OPERATED SINGLE-POLE, 3000-AMPERE

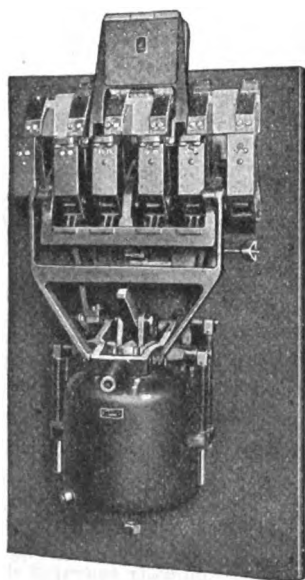


FIG. 5—ELECTRICALLY-OPERATED, REMOTE-CONTROL, SINGLE-POLE, 20,000-AMPERE, WITH REVERSE-CURRENT-TRIP ATTACHMENT

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

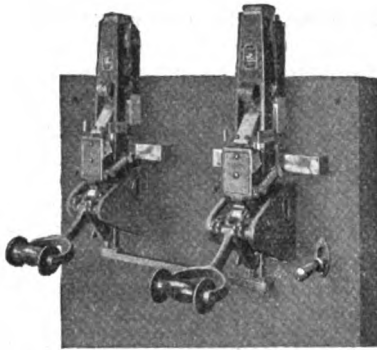


FIG. 8—MANUALLY-OPERATED DIRECT-CONTROL TWO-POLE 2500-AMPERE WITH EQUALIZER CONTACTS, UNDER-VOLTAGE AND COMMON TRIPS

The electrically-operated multipole breakers can be supplied on special order in any standard number of poles and in any standard ampere capacity in

which the type CA line is listed, with a separate electro-magnet for closing each pole and a single shunt-trip magnet acting through a common trip mechanism for tripping all poles of the breaker together.

Single electro-magnets are usually supplied for closing all capacities of breakers up to 8000 amperes four poles, 14,000 amperes three poles, and 20,000 amperes two poles, simultaneously.

Type CA Multipole Circuit-Breaker Standard Mounting Centers (Distance Between Center Lines of Individual Poles)

Amperes Direct-Current	300 AND 750-VOLT SERVICE	
	Standard Distance With or Without Barriers, Inches	Minimum Distance With Barriers, Inches
400 to 2500	10	7
3000 to 4000	13	10
6000	16	13
8000	18	15
10000	20	17
14000	24	20

ACCESSORIES

Auxiliary Tripping Attachments

**Attachments Applied**—Any single auxiliary trip attachment is arranged to trip all poles of a multipole type CA carbon circuit-breaker, and therefore one attachment can be used for all poles. If proper space between poles (or pole centers) is allowed, one

attachment per pole can be used, if desired. The usual location for the shunt-trip is on the right side of the breaker when facing the front of the panel, the under-voltage trip on the left side, the inverse-time-limit below the breaker; the reverse-current trip is also located below the breaker and below the time-limit attachment if used; the equalizer contacts on

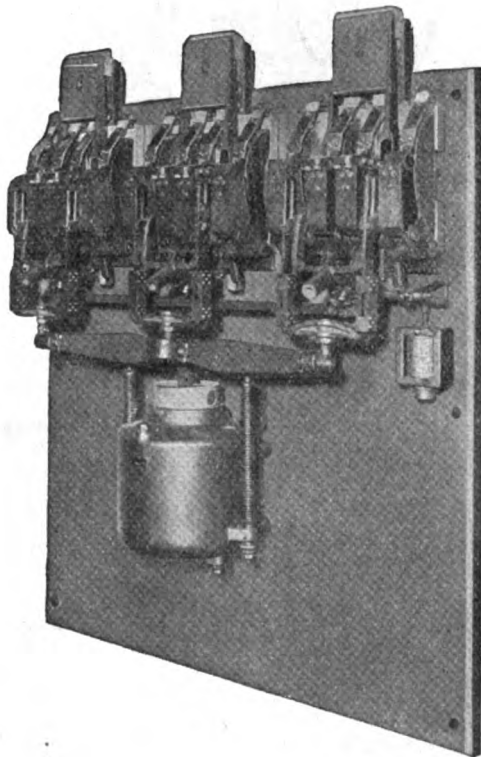


FIG. 7—ELECTRICALLY-OPERATED THREE-POLE 12,000-AMPERE

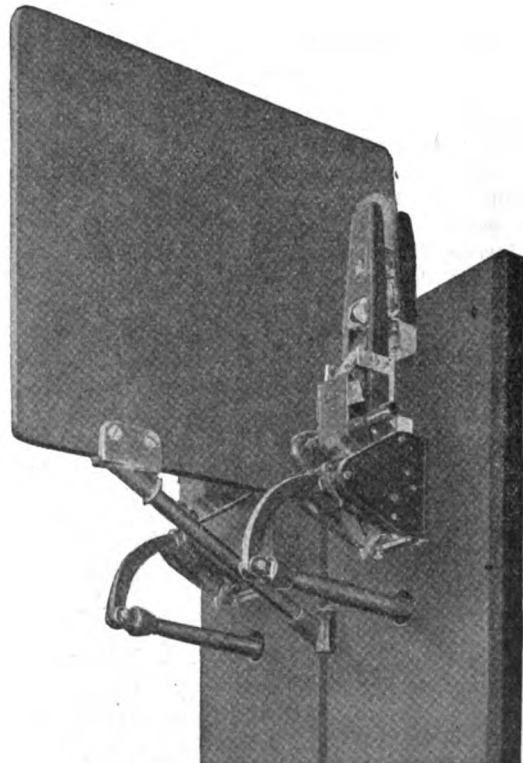


FIG. 9—MANUALLY-OPERATED REMOTE-CONTROL SINGLE-POLE 400-AMPERE 1500-VOLT, WITH BARRIER

## TYPE CA CARBON CIRCUIT-BREAKERS—Continued

and behind, but insulated from and supported by the main contact brush or bridge; and the signal-con-

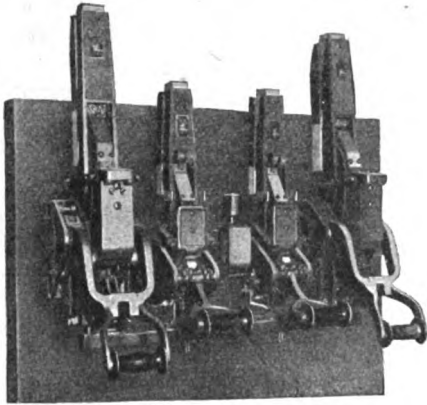


FIG. 10—MANUALLY-OPERATED DIRECT-CONTROL SPECIAL FOUR-POLE EQUALIZER BREAKER WITH UNDERVOLTAGE ATTACHMENT AND COMMON TRIP

tact attachment behind the panel, between the contact terminal studs of the breaker. The electric operating solenoid magnet is mounted below the breaker proper at various distances as required by the presence or absence of any of the attachments that are mounted below the breaker.

**Shunt-Trip Attachment**—Direct-current shunt-trip attachments arranged for mounting on the front of the panel are listed for all capacities of manually-operated type CA breakers.

**Automatic Undervoltage-Trip Attachment**—A direct-current automatic undervoltage-trip attachment is listed for the several capacities of type CA breaker. This attachment is reset automatically by the opening of the circuit-breaker.

An alternating-current undervoltage-trip attachment similar to the direct-current attachment can be supplied on special order.

**Inverse-Time-Limit Attachment**—An inverse-time-limit dashpot with an adjustable time feature is listed for all sizes of type CA breakers up to and including 2500 amperes direct-current and 1600 amperes alternating-current, in any number of poles up to four poles, and for both manually or electrically-operated breakers. A similar attachment for the larger capacity breakers can be supplied on special order.

**Reverse-Current Trip Attachment**—An attachment for tripping the type CA carbon circuit-breaker on reversal of current in direct-current service is listed to be applied to any regular type CA carbon circuit-breakers of capacities up to 20,000 amperes.

### Equalizer Contacts

Equalizer contacts are listed and can be provided on type CA breakers in capacities up to 2500 amperes direct current, but are not provided with overload protection in the equalizer circuit. Equalizer contacts are not usually supplied above 2500 amperes capacity, direct current. Either standard multipole breakers or special multipole breakers having equalizer poles of lower capacity than the main poles can be used.

### Barriers

Barriers are not included with the standard breakers and where needed should be ordered separately from pages listing accessories.

### Bases

Unless otherwise specified on entry of order, standard breakers will be shipped on scrap slate or wood templates. When specified on entry of order, black marine slate bases of standard sizes, will be furnished with no addition to the price.

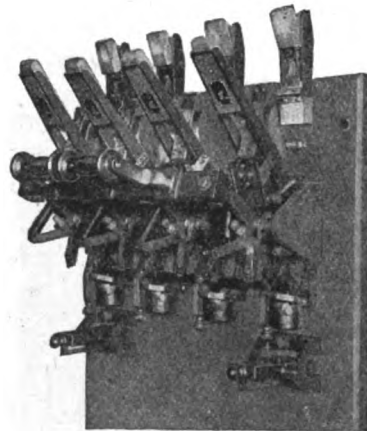


FIG. 11—MANUALLY-OPERATED DIRECT-CONTROL FOUR-POLE 1000-AMPERE, WITH INVERSE-TIME-LIMIT AND AUTOMATIC-REVERSE-CURRENT TRIP ATTACHMENTS

## TYPE CA CARBON CIRCUIT-BREAKERS—Continued

## MANUALLY-OPERATED TYPE CA CARBON CIRCUIT-BREAKERS

## For Direct Current

## Plain Automatic Single-Pole Rear-Connected

MAX. AMPERES		Approx. Shipping Wt., Lbs.	Style No.	List Price
30° Rating	20° Rating			
400	400	130	262561	\$167 00
600	600	135	261067	182 00
800	800	140	271971	182 00
1200	1000	150	271973	241 00
1600	1200	145	261087	281 00
2000	1600	150	233102	334 00
3000	2400	250	229553	465 00
4000	3000	325	233108	600 00
6000	5000	450	198468	880 00
8000	6000	*	198467	1140 00
10000	9000	*	198468	1350 00
14000	12000	*	198469	2000 00

## For 25-Cycle Alternating Current

## Plain Automatic Single-Pole Rear-Connected

MAX. AMPERES		Approx. Shipping Wt., Lbs.	Style No.	List Price
30° Rating	20° Rating			
400	400	130	286963	\$167 00
600	600	135	261075	182 00
800	800	140	249412	182 00
1200	1000	140	249414	241 00
1500	1200	145	261183	281 00
1800	1400	150	261184	334 00
2750	2400	250	247618	465 00
3500	3000	325	247619	600 00
4500	4000	400	247620	880 00
6000	5000	500	247621	1140 00
8000	6000	*	247622	1350 00
10000	8000	*	247623	2000 00

## For 60-Cycle Alternating Current

## Plain Automatic Single-Pole Rear-Connected

MAX. AMPERES		Approx. Shipping Wt., Lbs.	Style No.	List Price
30° Rating	20° Rating			
400	400	130	286964	\$167 00
600	600	135	261077	182 00
800	800	140	249423	182 00
1000	900	140	249424	241 00
1200	1000	145	261194	281 00
1600	1200	150	261195	334 00
2400	2000	150	247642	465 00
3000	2400	325	247643	600 00
4000	3000	400	247644	880 00
5000	4000	500	247645	1140 00
6000	5000	650	247646	1350 00
7000	6000	*	247647	2000 00

\*Approximate shipping weights will be furnished on request.

**Bases**—Style number and list price include breaker mounted on a wood or slate template. When specified on the order, standard size, black marine, slate bases will be supplied without additional charge.

**Studs**—Breakers are supplied with round studs for capacities up to and including 1200 amperes, d-c., 30 degree rating. Above that capacity standard breakers are supplied with the top stud horizontally laminated and the bottom stud vertically laminated.

**Terminals** are included in the style number and price on one stud per pole for 800 amperes and below. If specified at the entry of the order they will be similarly supplied on the 1200 ampere, d-c., 30-degree rating, breakers at regular prices. For additional terminals refer to section on "Switchboard Details."

**Sufficient nuts** per stud to clamp the breaker and to make connections to carry the rated current are included in the style number and price of round stud breakers but not of laminated-stud breakers.

**Attachments**—For inverse-time-limit, undervoltage-release and shunt trip attachments, reverse-current mechanism, signal contacts, and electric operating mechanism for use with the above breakers, refer to pages following those listing the breakers.

Standard breakers are supplied with a calibration range of 80 to 160 per cent of the 30-degree rating.

Order by Style Number

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

MULTIPOLE MANUALLY-OPERATED TYPE CA CARBON CIRCUIT-BREAKERS

750 Volts

Multipole manually-operated breakers with separate closing handles per pole and common trip, can be supplied up to and including 8000 amperes\* capacity direct current, 6000 amperes\* capacity 25-cycle alternating current, and 5000 amperes\* capacity 60-cycle alternating current, will have a total list price equal to the sum of the list prices of the corresponding single-pole panel-mounting breakers.

Multipole manually-operated breakers with single closing handle, cross-bar, and common trip will be supplied on breakers up to and including 2500 amperes\* capacity direct current, 2000 amperes capacity\* 25-cycle alternating current, and 1600 amperes\* capacity 60-cycle alternating current, at the same price as the sum of the list prices of the corresponding single-pole panel-mounting breakers, making up the multipole breaker.

\*30° basis of rating.

LIST PRICES

DIRECT CURRENT

Amperes 30° Rating	Two-Pole	Three-Pole	Four-Pole
400	\$338 00	\$510 00	\$675 00
600	375 00	565 00	750 00
800	375 00	565 00	750 00
1200	485 00	730 00	970 00
1600	565 00	850 00	1130 00
2000	695 00	1140 00	1390 00
3000	975 00	1470 00	.....
4000	1240 00	1870 00	.....
6000	1800 00	2720 00	.....

25-CYCLE ALTERNATING CURRENT

400	338 00	510 00	675 00
600	375 00	565 00	750 00
800	375 00	565 00	750 00
1200	485 00	730 00	970 00
1500	565 00	850 00	1130 00
1800	695 00	1140 00	1390 00
2750	975 00	1470 00	.....
3500	1240 00	1870 00	.....
4500	1800 00	2720 00	.....

60-CYCLE ALTERNATING CURRENT

400	338 00	510 00	675 00
600	375 00	565 00	750 00
800	375 00	565 00	750 00
1200	485 00	730 00	970 00
1600	565 00	850 00	1130 00
2400	695 00	1140 00	1390 00
3000	975 00	1470 00	.....
4000	1240 00	1870 00	.....
5000	1800 00	2720 00	.....



TYPE CA CARBON CIRCUIT-BREAKERS—Continued

ELECTRICALLY-OPERATED TYPE CA CARBON CIRCUIT-BREAKERS

The electrically operated type CA carbon circuit-breakers will have a total list price equal to the list price of the corresponding manually-operated breaker, plus the list price of the proper electric mechanism indicated below. The list prices speci-

fied include closing and tripping magnets complete with closing and tripping coils when these parts are included with hand-operated breakers to make electrically-operated breakers. These list prices do not cover these parts when the parts are sold alone.

ELECTRIC MECHANISM

AMPERE CAPACITY OF BREAKERS*			
Direct Current	ALTERNATING CURRENT		List Price†
	25-Cycle	60-Cycle	
400 to 2000	400 to 2000	400 to 1600	\$150 00
3000 to 4000†	2750 to 3500	2400 to 3000	327 00
6000 to 8000	4500 to 6000	4000 to 5000	327 00
10000 to 14000	8000 to 10000	6000 to 7000	420 00
	<b>Two-Pole</b>		
400 to 2500	400 to 2000	400 to 1600	254 00
3000 to 4000	2700 to 3500	2400 to 3000	405 00
6000 to 14000	4500 to 10000	4000 to 7000	740 00
	<b>Three-Pole</b>		
400 to 2500	400 to 2000	400 to 1600	327 00
3000 to 4000	2750 to 3500	2400 to 3000	405 00
6000 to 8000	4500 to 6000	4000 to 5000	740 00
10000 to 14000	8000 to 10000	6000 to 7000	925 00

\*30° basis of rating.

†The prices shown are not for the parts themselves but are additional prices covering breaker and mechanism on the same order. Order by description, referring to similar listed style number breakers.

CONTACTOR-TYPE  
ELECTRICALLY-OPERATED  
CARBON CIRCUIT-BREAKERS

Single-Pole—750 Volts

AMPERE CAPACITY OF BREAKERS*				Price	Amperes
Direct Current	ALTERNATING CURRENT		Studs		
25-Cycle	60-Cycle				
1200	1200	1000	Round	↑	400
1500	1600	1200	Round	↑	600
1800	2000	1600	Round	↑	800
2750	3000	2400	Laminated	↑	
3500	4000	3000	Laminated	↑	
4500	6000	4000	Laminated	↑	

\*30° basis of rating.

†The list price of the contactor-type circuit-breaker is the same as that for the corresponding single-pole electrically-operated breaker. These circuit-breakers are made only in the capacities given.

MANUALLY-OPERATED  
REMOTE-CONTROL CARBON  
CIRCUIT-BREAKERS

Single-Pole—1500 Volts  
For Direct Current  
Automatic—Round-Stud

Amperes	List Price	Amperes	List Price
400	↑	1200	↑
600	↑	1600	↑
800	↑	2000	↑

†The manually operated, remote-control, automatic single-pole, round-stud breakers will have a total list price equal to the list price of the corresponding manually-operated 750-volt panel-mounting breaker in Table 2, plus a list price of \$110.00.

For information as to what material is furnished with these breakers, see "Instructions for Ordering Carbon Circuit-Breakers" on a previous page.

TYPE CA FIELD-DISCHARGE CIRCUIT-BREAKERS

Manually and Electrically-Operated

250 Volts—Direct Current

MANUALLY-OPERATED  
BREAKERS

ELECTRICALLY-OPERATED BREAKERS  
Electric Operating Mechanism for  
Voltages of 93 to 143

Max. Amps.	STYLE No.				List Price	Max. Amps.	STYLE No.		List Price
	SINGLE-POLE WITHOUT SHUNT TRIP		TWO-POLE WITHOUT SHUNT TRIP				Single-Pole	Two-Pole	
800	268174	268179	268184	268189	*	800	268194	268199	*
1200	268175	268180	268185	268190	*	1200	268195	268200	*
1600	268176	268181	268186	268191	*	1600	268196	268201	*
2000	268177	268182	268187	268192	*	2000	268197	268202	*

\*Prices will be furnished on request.

Order by Style Number

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

ACCESSORIES FOR TYPE CA CARBON CIRCUIT-BREAKERS

The list prices given for the following accessories cover assembly with the breaker at the Works and are additional to the list price of the breaker.

SHUNT-TRIP ATTACHMENTS

Style number does not include coil or cutout, which must be specified on order by style number from table below. List price includes mechanism with coil but without cutout, which is priced below.

BREAKERS			APPROX. WT., LBS.		Style No.	List Price
Capacity Amperes D-C.	Poles	Overload	Net	Boxed		
400 to 2000	Single-pole	*	6	8	235877	\$20 00
400 to 2000	Multipole	*	6	8	235878	20 00
3000	Single-pole and Multipole	*	8	12	235881	20 00
4000	Single-pole and Multipole	*	8	12	235881	20 00
6000	Single-pole and Multipole	Auto.	8	12	235882	20 00
6000	Single-pole and Multipole	Non-auto.	8	12	235883	20 00
8000	Single-pole and Multipole	Auto.	8	12	235884	20 00
8000	Single-pole and Multipole	Non-auto.	8	12	235885	20 00
10000	Single-pole and Multipole	Auto.	11	17	240488	20 00
10000	Single-pole and Multipole	Non-auto.	11	17	240489	20 00
14000	Single-pole and Multipole	Auto.	11	17	240490	20 00
14000	Single-pole and Multipole	Non-auto.	11	17	240491	20 00

\*For either automatic or non-automatic breakers.

COILS FOR SHUNT-TRIP ATTACHMENT

The coils listed below are for use with the above shunt-trip attachments and must be ordered separately.

Breaker Capacity Amperes D-C.	Volts D-C.	APPROX. WT., LBS.		Style No.
		Net	Boxed	
400 to 2000	110	1 1/2	2 1/2	272861
400 to 2000	125	1 1/2	2 1/2	235879
400 to 2000	220	1 1/2	2 1/2	272862
400 to 2000	250	1 1/2	2 1/2	235887
400 to 2000	500 and 600	1 1/2	2 1/2	220619
3000 to 8000	110 and 125	2 1/2	4	272931
3000 to 8000	220 and 250	2 1/2	4	272932
3000 to 8000	440 and 500	2 1/2	4	272933
3000 to 8000	600	2 1/2	4	272934
3000 to 8000	750	2 1/2	4	201397
10000 to 14000	110 and 125	3 1/2	5	240485
10000 to 14000	220 and 250	3 1/2	5	240486
10000 to 14000	440, 500 and 600	3 1/2	5	240487

UNDERVOLTAGE RELEASE ATTACHMENTS

Style number includes mechanism complete without coil. List price includes mechanism complete with coil which must be specified from table below.

BREAKER			APPROX. WT., LBS.		Style No. for D-C. Control	Style No. for A-C. Control	List Price
Capacity Amperes, D-C.	Poles	Overload	Net	Boxed			
400 to 2000	Single	*	9	11	240492	304467	\$25 00
400 to 2000	Multipole	*	9	11	240493	304468	25 00
3000 and 4000	Single	*	12	16	241168	304469	25 00
3000 and 4000	Multipole	*	12	16	241173	304470	25 00
6000	Single	Auto	12	16	241169	304471	25 00
6000	Single	Non-auto	12	16	241170	304473	25 00
6000	Multipole	Auto	12	16	241174	304472	25 00
6000	Multipole	Non-auto	12	16	241175	304474	25 00
8000	Single	Auto	12	16	241171	304475	25 00
8000	Single	Non-auto	12	16	241172	304477	25 00
8000	Multipole	Auto	12	16	241176	304476	25 00
8000	Multipole	Non-auto	12	16	241177	304478	25 00
10000	Single	Auto	20	26	272863	304479	25 00
10000	Single	Non-auto	20	26	272864	304481	25 00
10000	Multipole	Auto	20	26	272867	304480	25 00
10000	Multipole	Non-auto	20	26	272868	304482	25 00
14000	Single	Auto	20	26	272865	304483	25 00
14000	Single	Non-auto	20	26	272866	304485	25 00
14000	Multipole	Auto	20	26	272869	304484	25 00
14000	Multipole	Non-auto	20	26	272870	304486	25 00

For Breakers with Equalizer Contacts

Single	*	12	17	272880	.....	25 00
Multipole	*	12	17	272881	.....	25 00

\*For either automatic or non-automatic breakers.

Order by Style Number

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

COILS FOR UNDERVOLTAGE RELEASE ATTACHMENTS

The coils listed below are for use with the above undervoltage mechanisms and must be ordered separately.

BREAKER Capacity Amp. D-C. and A-C.	Volts D-C.	Volts 60-Cycles	APPROX. WT., LBS.		Style No. A-C.	Style No. D-C
			Net	Boxed		
400 to 2000	125	125	1 1/4	2 1/4	304487	240494
3000 to 8000	125	125	2 1/2	4	304488	272860
10000 to 14000	125	125	3 1/2	5	304489	241190

For Breaker with Equalizer Contacts

150 to 4500	125	1 1/2	2 1/2	.....	201480
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INVERSE-TIME LIMIT ATTACHMENTS

One inverse-time-limit attachment required for each overload trip mechanism.

BREAKER Capacity Amperes, D-C.	With Reverse Current Trip	Poles	APPROX. WT., LBS.		Style No.	List Price
			Net	Boxed		
400 to 2000	No	Multipole	4	6	233068	\$60 00
400 to 2000	Yes	Multipole	4	6	233087	60 00
400 to 2000	No	Single	4	6	272884	60 00
400 to 2000	Yes	Single	4	6	272885	60 00
3000 and 4000	No	Single or Multipole	8	12	272886	67 00
6000	No	Single or Multipole	15	22	272887	67 00
8000	No	Single or Multipole	15	22	272888	67 00
10000	No	Single or Multipole	15	22	272889	67 00
14000	No	Single or Multipole	15	22	272890	67 00

Barriers with Brackets

Style number and list price include barrier complete with brackets for mounting on panel.

Description	Style No.	List Price
Black Marine-finished Slate.....	249529	\$53 00
Monson Slate.....	*	55 00
Blue Vermont Marble.....	*	63 00
Black Marine-finished Marble....	*	59 00

\*Order by description.

Reverse-Current-Trip Attachments

Style number and list price include mechanism complete without shunt coils. List price includes mechanism complete with coils which must be specified on order from table below.

Breaker Capacity Amperes D-C.	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
<b>For Breaker without Inverse-Time-Limit</b>				
400	15	20	241431	\$165 00
600 and 800	15	20	241432	165 00
1000 to 2000	15	20	241433	202 00
3000 and 4000 (auto)	15	20	241436	254 00
3000 and 4000 (non-auto)	15	20	241435	254 00
<b>For Breaker with Inverse-Time-Limit</b>				
400	15	20	241438	168 00
600 and 800	15	20	241439	168 00
1000 to 2000	15	20	270452	202 50
3000 and 4000	15	20	270466	268 00

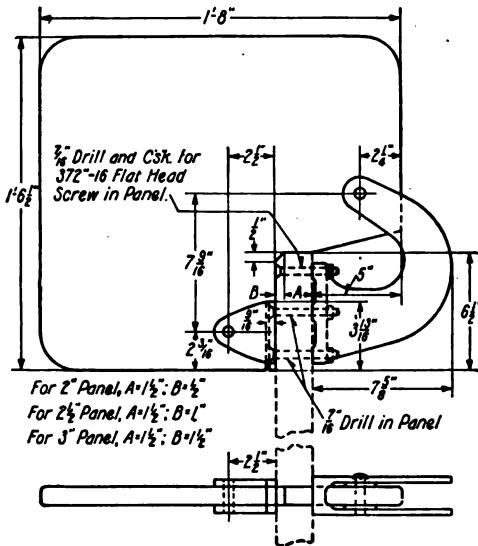


FIG. 12—DIMENSIONS OF BARRIER STYLE NO. 249529 WITH BRACKETS

COILS FOR REVERSE-CURRENT TRIP ATTACHMENTS

The coils listed below are for use with the reverse-current trip attachments listed on the preceding page and must be ordered separately. Four coils are required with each trip mechanism.

Volts	APPROXIMATE WEIGHT, POUNDS		Style No.
	Net	Boxed	
125	1 1/4	2 1/4	241442
250	1 1/4	2 1/4	241443
600	1 1/2	2 1/2	241445

These dimensions are for reference only. For official dimensions apply to nearest district office.

Order by Style Number

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

EQUALIZER CONTACTS

Breaker Capacity Amperes D.-C.	APPROX. WEIGHT, POUNDS		Style No.	List Price
	Net	Boxed		
400	5	8	272891	\$89 00
600 and 800	8	12	272892	89 00
1000 to 2000	11	16	272893	105 00

SIGNAL AND AUXILIARY-CIRCUIT SWITCHES

One form of signal and auxiliary-circuit switches is listed.

One set of contacts is normally closed while the other set is normally open; pushing the button opens the first set of contacts and then closes the second set. The contacts are of the sliding type, which insures good electrical connection regardless of side thrust in the operation of the plunger. This switch is single-pole, double-throw, and is adapted for use in auxiliary circuits for such purposes as ringing alarm bells, operating shunt trip or no-voltage release for electrically-operated circuit-breakers, interlocking circuits, etc.

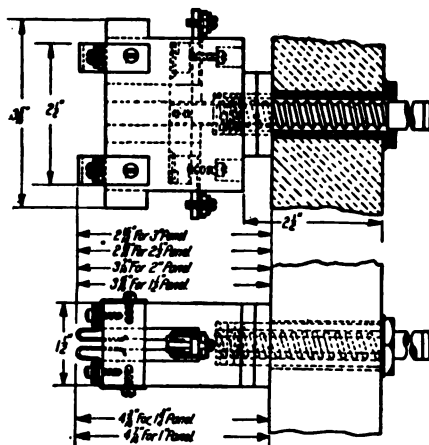


FIG. 13—STYLE NO. 101941

Used with Capacity of Breakers	Capacity Amperes	Maximum Volts	Amperes Interrupting Capacity	Number Contacts	Panel Thickness Inches	Style No.	List Price Each
Up to 2500 amperes	10 at 250 V. 5 at 600 V.	600	10 at 250 V. 5 at 600 V.	.....	2 1/4	101941	\$11 00
3000 amperes and higher	5 at 600 V.	600	5 at 600 V.	.....	2 1/2	248981	17 00
3000 amperes and higher	5 at 600 V.	600	5 at 600 V.	.....	3	248982	17 00
3000 amperes and higher	5 at 600 V.	600	5 at 600 V.	.....	3 1/2	248983	17 00
Spacer for use with style Nos. 101941 and 248981 for each one-quarter inch panel that is thinner than 2 1/4 inches.	.....	.....	.....	.....	.....	270305	20

CONTROL SWITCHES AND CONTROL RELAYS

For the prices, weights and dimensions of control switches (drum control switches) and control relays, refer to Section 2-B on Switchboard Accessories.

BLACK MARINE-FINISHED SLATE BASES

No. of Breaker Poles	Style No.	SIZE IN INCHES			APPROX. WT., LBS.		List Price	No. of Breaker Poles	Style No.	SIZE IN INCHES			APPROX. WT., LBS.		List Price
		Ht.	Width	Thick- ness	Net	Boxed				Ht.	Width	Thick- ness	Net	Boxed	
1	267793	20	16	2	145	179	\$24 25	1	267814	20	16	2	65	89	\$30 50
1	267794	20	16	2	145	179	24 50	1	267815	20	16	2	65	89	32 25
1	267795	20	16	2	145	179	25 00	1	267816	20	16	2	65	89	33 25
1	267796	20	16	2	145	179	25 00	1	267817	20	16	2	65	89	33 25
1	267797	20	16	2	145	179	26 75	1	267818	20	16	2	65	89	34 75
1	267798	20	16	2	145	179	28 25	1	267819	20	16	2	65	89	34 75
1	267799	20	16	2	145	179	28 25	1	267820	20	16	2	65	89	34 75
1	267800	20	16	2	145	179	29 25	1	267821	20	16	2	65	89	34 75
1	267801	20	16	2	145	179	32 25	1	267822	20	16	2	65	89	36 25
1	267802	20	36	2	145	179	32 25	1	267823	20	16	2	65	89	36 25
1	267893	25	20	2	100	130	38 25	1	267824	25	20	2	100	130	48 50
1	267804	25	20	2	100	130	38 25	1	267825	25	20	2	100	130	48 50
1	267806	25	20	2	100	130	38 25	1	267826	25	20	2	100	130	49 75
1	267808	25	24	2 1/4	155	190	45 75	1	267827	25	20	2	100	130	49 75
1	267810	25	24	2 1/4	155	190	53 50	1	267828	25	24	2 1/4	155	190	61 50
1	267811	20	16	2	65	89	30 50	1	267829	25	24	2 1/4	155	190	61 50
1	267812	20	16	2	65	89	30 50	1	267830	25	24	2 1/4	155	190	66 00
1	267813	20	16	2	65	89	30 50	1	267831	25	24	2 1/4	155	190	66 00

These dimensions are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number



TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Manually-Operated—Automatic—Single-Pole—750 Volts  
Capacities Based on 30-Degree Rating

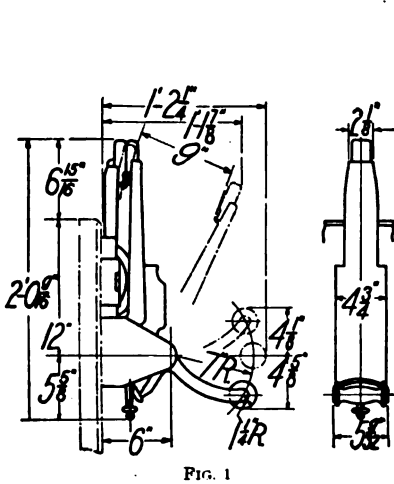


FIG. 1

400 TO 2500 AMPERES, D-C.  
400 TO 2000 AMPERES, 25 CYCLES A-C.  
400 TO 1600 AMPERES, 60 CYCLES, A-C

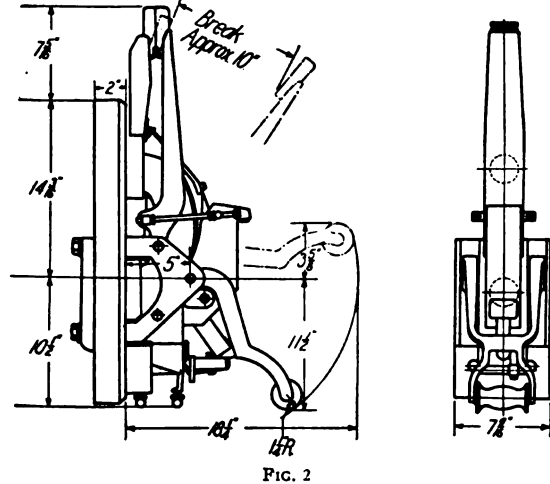


FIG. 2

3000 AND 4000 AMPERES, D-C.  
2750 AND 3500 AMPERES, 25 CYCLES, A-C.  
2400 AND 3000 AMPERES, 60 CYCLES, A-C.

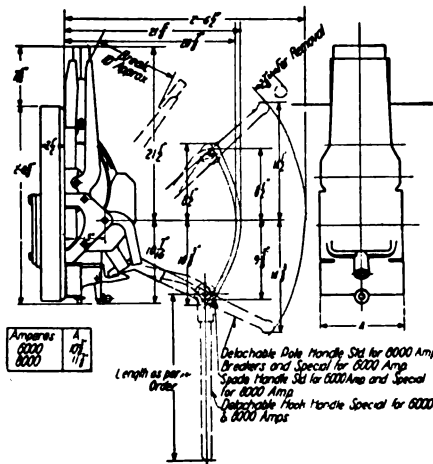


FIG. 3

6000 AND 8000 AMPERES, D-C.  
4500 AND 6000 AMPERES, 25 CYCLES, A-C.  
4000 AND 5000 AMPERES, 60 CYCLES, A-C.

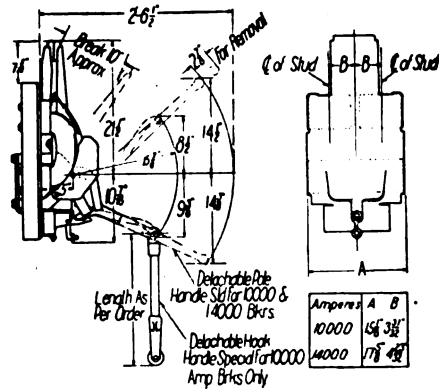


FIG. 4

10000 AND 14000 AMPERES, D-C.  
8000 AND 10000 AMPERES, 25 CYCLES, A-C.  
6000 AND 7000 AMPERES, 60 CYCLES, A-C.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Manually-Operated—Automatic—Single-Pole—750 Volts

Round and Laminated Studs

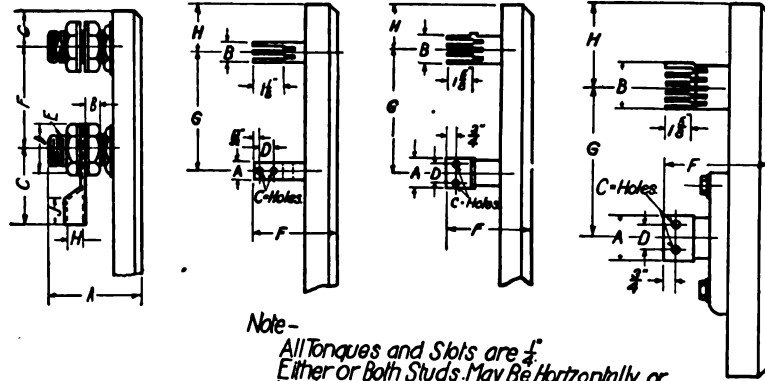


FIG. 5

FIG. 6

FIG. 7

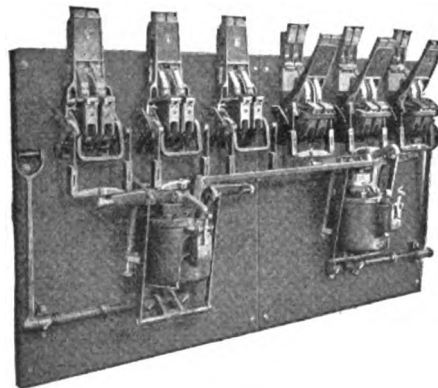
FIG. 8

Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E†	F	G	H	J	
400	5	5 1/2	1 1/2	2 1/2	1 1/2	5/8-11	6 5/8	2 3/8	.918	1 1/2	
600	5	5 3/4	1 3/4	3 1/8	1 3/8	3/4-16	6 1/2	2 1/2	1.28	1 1/2	
800	5	5 3/4	1 3/4	2 7/8	1 3/8	1 -14	6 1/8	2 1/8	↑.918	1 1/2	
1000	5	5 3/4	1 3/4	...	1 3/8	1 -14	8	3	.....	...	
1200	5	5 3/4	1 3/4	...	2 1/8	1 1/2-14	8	3	.....	...	
1600	5	6 1/4	2 1/4	...	2 1/2	1 1/2-14	8	3	.....	...	
2000	5	6 1/2	2 1/2	...	3	1 3/4-12	8	3	.....	...	

†Two terminals per stud.  
‡Diameter in inches and number of threads per inch.

Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E*	F	G	H	I†	
1600	6	1 1/4	1 1/4	1 1/4	1 1/4	3	5 1/2	7 1/2	3 1/2	1	
2000	6	1 1/4	1 1/4	1 1/4	1 1/4	3	5 1/2	7 1/2	3 1/2	1	
2500	7	2	1 3/4	1 3/4	1 3/4	4	5 1/2	8	3	1	
3000	8	2 1/2	2 1/4	1 3/4	1 3/4	5	6 1/2	9 1/2	5 1/2	1	
4000	8	3	2 3/4	1 3/4	1 3/4	6	6 1/2	9 1/2	5 1/2	1	
6000	8	4	2 3/4	1 3/4	1 3/4	8	7 1/2	9 1/2	5 1/2	1	
8000	8	4 1/2	4 1/4	1 3/4	2 1/2	9	7 1/2	9 1/2	5 1/2	1	
10000	8	4	3 3/4	1 3/4	2	8	8 1/2	9 1/2	5 1/2	1	
14000	8	4 1/2	4 1/4	1 3/4	2 1/2	9	8 1/2	9 1/2	5 1/2	2	

\*Number of tongues.  
†Number of studs.  
These dimensions are for reference only. For official dimensions apply to nearest district office.



TYPE CA CARBON CIRCUIT-BREAKERS, ELECTRICALLY-OPERATED, THREE-POLE, DOUBLE-THROW, 4000 AMPERES, 60 CYCLES, NON-AUTOMATIC, WITH DIRECT-CURRENT CONTROL

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Electrically-Operated—Automatic—Single-Pole—750 Volts

Capacities Based on 30-Degree Rating

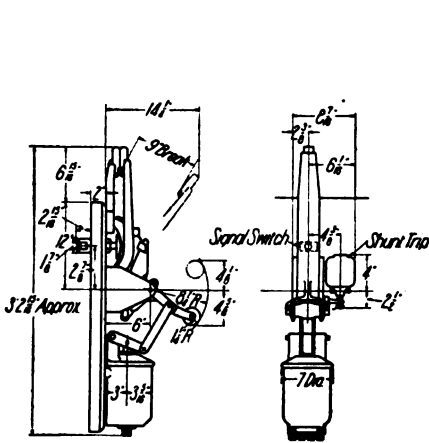


FIG. 1

400 TO 2500 AMPERES, D-C.  
400 TO 2000 AMPERES, 25 CYCLES, A-C.  
400 TO 1600 AMPERES, 60 CYCLES, A-C.

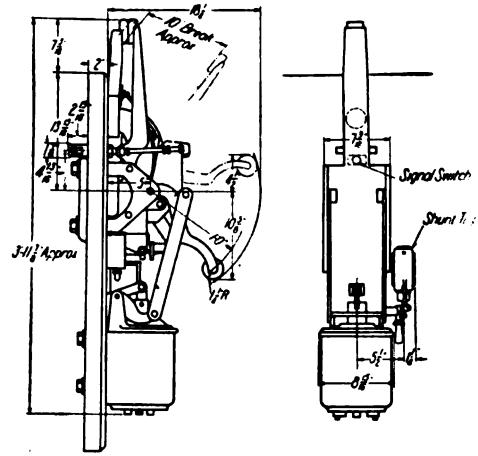


FIG. 2

3000 AND 4000 AMPERES, D-C.  
2750 AND 3500 AMPERES, 25 CYCLES, A-C.  
2400 AND 3000 AMPERES, 60 CYCLES, A-C.

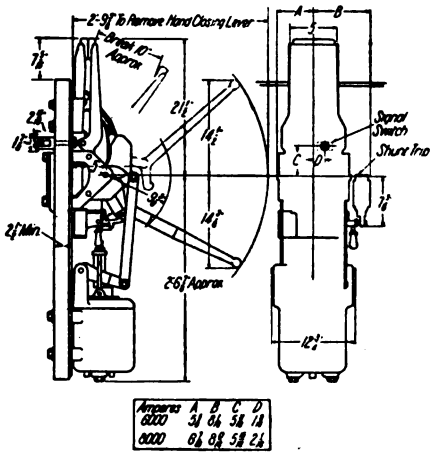


FIG. 3

6000 AND 8000 AMPERES, D-C.  
4500 AND 6000 AMPERES, 25 CYCLES, A-C.  
4000 AND 5000 AMPERES, 60 CYCLES, A-C.

Amperes	A	B	C	D
6000	5 1/2	6 1/8	5 1/8	1 1/8
8000	6 1/8	6 1/8	5 1/8	2 1/8

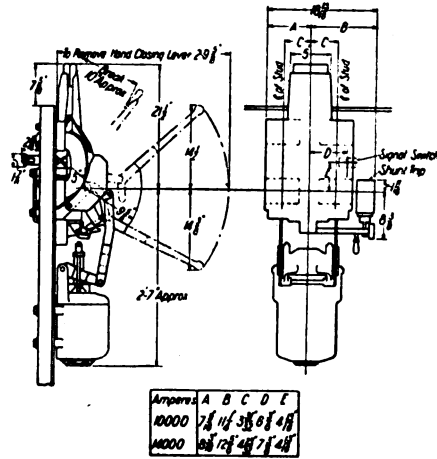


FIG. 4

10000 AND 14000 AMPERES, D-C.  
8000 AND 10000 AMPERES, 25 CYCLES, A-C.  
6000 AND 7000 AMPERES, 60 CYCLES, A-C.

Amperes	A	B	C	D	E
10000	7 1/2	11 3/8	8 1/8	4 1/8	
14000	8 1/8	12 1/8	4 1/8	7 1/8	4 1/8

These dimensions are for reference only. For official dimensions apply to nearest district office.



TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Electrically-Operated—Automatic—Single-Pole—750 Volts

Capacities Based on 30-Degree Rating

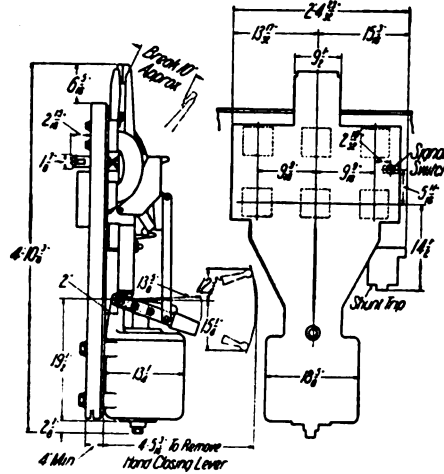


FIG. 5—20,000 AMPERES, D-C.

Round and Laminated Studs

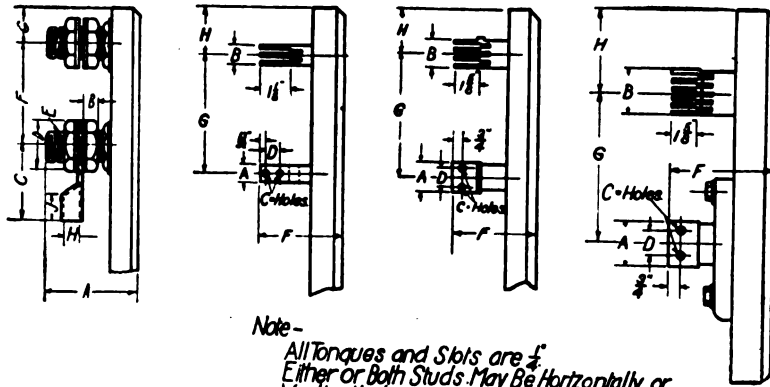


FIG. 6

FIG. 7

FIG. 8

FIG. 9

D-C. Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E†	F	G	H	J	
400	6	5 1/2	3/8	2 3/8	1 1/8	5/8-11	6 3/8	2 1/2	.918	1 1/2	
600	6	5 1/2	3/8	3 1/8	1 1/8	5/8-16	6 1/8	2 1/8	1.28	1 1/2	
800	6	5 1/2	3/8	2 3/4	1 1/8	1 -14	6 1/8	2 1/8	†.918	1 1/2	
1000	6	5 1/2	3/8	...	1 1/8	1 -14	8	3	.....	...	
1200	6	5 1/2	3/8	...	2 1/8	1 1/4-14	8	3	.....	...	
1600	6	6 1/4	3/8	...	2 1/2	1 1/2-14	8	3	.....	...	
2000	6	6 1/2	3/8	...	3	1 3/4-12	8	3	.....	...	

†Two terminals per stud. ‡Diameter in inches and number of threads per inch.

D-C. Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E*	F	G	H	I†	
1600	7	1 1/4	1 1/4	1/8	1/8	3	5 1/2	7 1/8	3 1/8	1	
2000	7	1 3/4	1 1/4	1/8	1/8	3	5 1/2	7 1/8	3 1/8	1	
2500	8	2	1 1/4	1/8	1/8	4	5 1/2	8	3	1	
3000	9	2 1/2	2 1/4	1/8	1 1/8	5	6 1/2	9 1/4	5 1/8	1	
4000	9	3	2 3/4	1/8	1 1/2	6	6 1/2	9 1/4	5 1/8	1	
6000	9	4	2 3/4	1/8	2	8	7 1/2	9 3/4	5 1/8	1	
8000	9	4 1/2	4 1/4	1/8	2 1/2	9	7 1/2	9 1/2	5 1/8	1	
10000	9	4	3 3/4	1/8	2	8	8 1/2	9 1/2	5 1/8	2	
14000	9	4 1/2	4 1/4	1/8	2 1/2	9	8 1/2	9 1/2	5 1/8	2	
20000	9	4 1/2	4 1/4	1/8	2 1/2	9	8 1/2	9 1/2	5 1/8	3	

\*Number of tongues. (Number of slots is one less than the number of tongues.) †Number of studs.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Electrically-Operated—Automatic—Multipole—750 Volts

Capacities Based on 30-Degree Rating

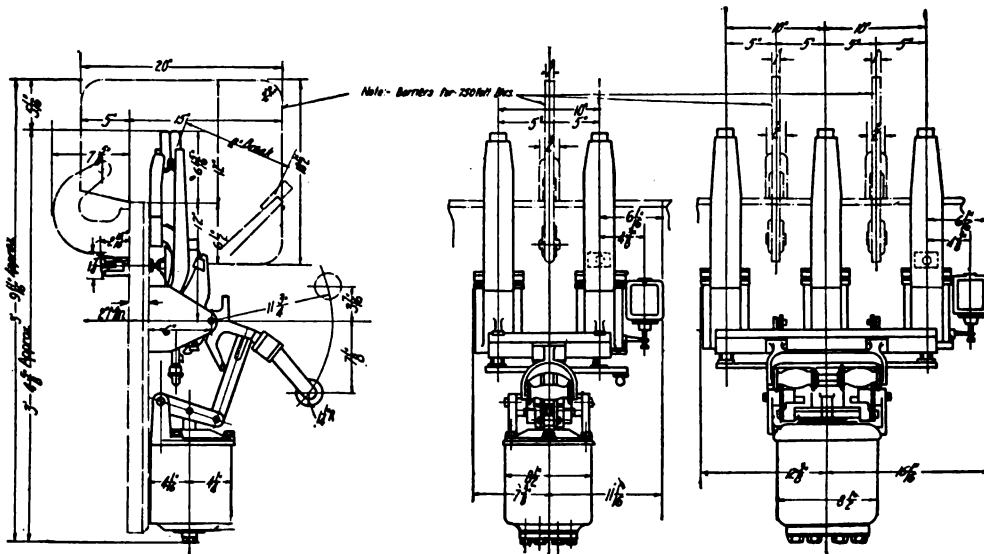


FIG. 1

400 TO 2500 AMPERES, D-C.  
 400 TO 2000 AMPERES, 25 CYCLES, A-C.  
 400 TO 1600 AMPERES, 60 CYCLES, A-C.

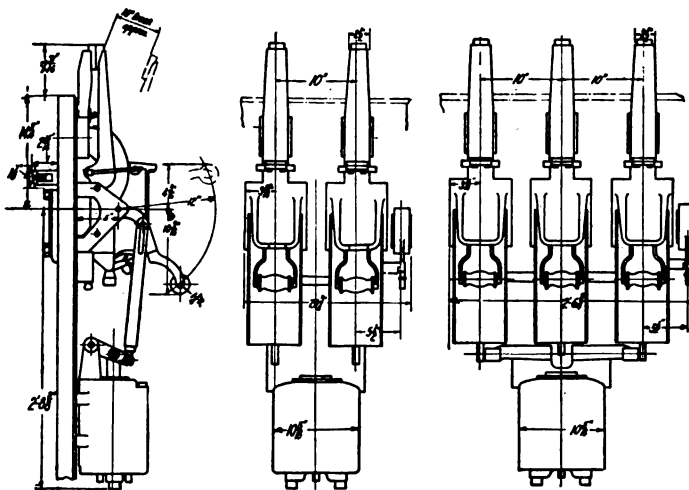


FIG. 2

3000 AND 4000 AMPERES, D-C.  
 2750 AND 3500 AMPERES, 25 CYCLES, A-C.  
 2400 AND 3000 AMPERES, 60 CYCLES, A-C.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Electrically-Operated—Automatic—Multipole—750 Volts

Capacities Based on 30-Degree Rating

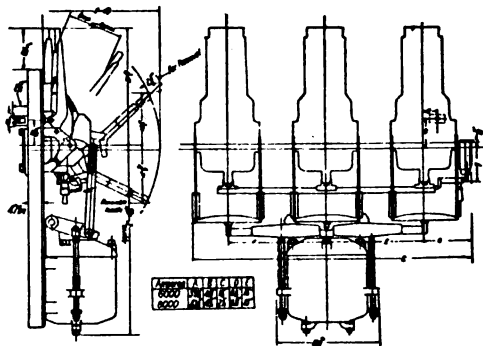


FIG. 3

6000 AND 8000 AMPERES, D-C.  
4500 AND 6000 AMPERES, 25 CYCLES, A-C.  
4000 AND 5000 AMPERES, 60 CYCLES, A-C.

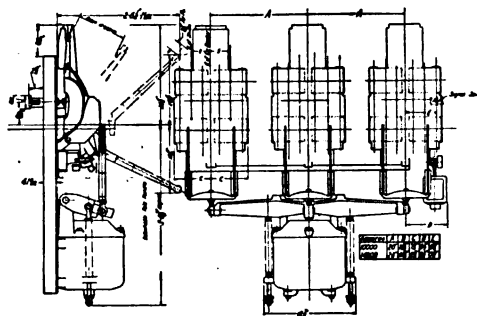


FIG. 4

10000 AND 14000 AMPERES, D-C.  
8000 AND 10000 AMPERES, 25 CYCLES, A-C.  
6000 AND 7000 AMPERES, 60 CYCLES, A-C.

Round and Laminated Studs

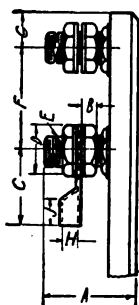


FIG. 5

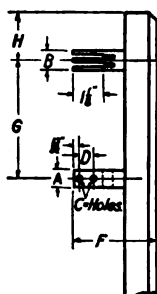


FIG. 6

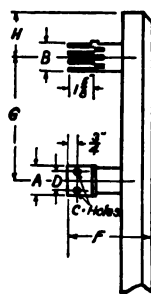


FIG. 7

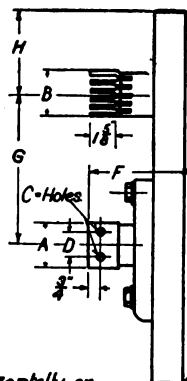


FIG. 8

Note—  
All Tongues and Slots are  $\frac{1}{8}$ "  
Either or Both Studs May Be Horizontally or Vertically Laminated.

D-C. Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	D	C	E†	F	G	H	J	
400	5	5 1/4	1 1/2	2 1/2	1 1/2	3/4-11	6 3/8	2 3/8	.918	1 3/8	
600	5	5 1/2	1 3/4	3 1/4	1 3/4	3/4-16	6 1/4	2 1/2	1.28	1 1/2	
800	5	5 1/2	1 3/4	2 3/4	1 3/4	1 -14	6 1/4	2 1/2	†.918	1 3/8	
1000	5	5 1/2	1 3/4	...	1 1/2	1 -14	8	3	.....	...	
1200	5	5 1/2	1 3/4	...	2 1/4	1 1/2-14	8	3	.....	...	
1600	5	6 1/4	1 3/4	...	2 1/2	1 1/2-14	8	3	.....	...	
2000	5	6 1/2	1 3/4	...	3	1 3/4-12	8	3	.....	...	

†Two terminals per stud.  
‡Diameter in inches and number of threads per inch.

D-C. Amperes	Fig.	DIMENSIONS IN INCHES									
		A	B	C	D	E*	F	G	H	I†	
1600	6	1 1/4	1 1/4	1 1/4	1 1/4	3	5 1/4	7 1/4	3 3/4	1	
2000	6	1 3/4	1 1/4	1 1/4	1 1/4	3	5 3/4	7 1/4	3 3/4	1	
2500	7	2	1 3/4	1 1/4	1 1/4	4	5 3/4	8	3	1	
3000	8	2 1/2	2 1/4	1 1/4	1 1/4	5	6 3/4	9 3/4	3 1/4	1	
4000	8	3	2 3/4	1 1/4	1 1/4	6	6 3/4	9 3/4	5 1/4	1	
6000	8	4	2 1/4	1 1/4	1 1/4	8	7 1/4	9 3/4	5 1/4	1	
8000	8	4 1/2	4 1/4	1 1/4	2 1/2	8	7 1/4	9 3/4	5 1/4	1	
10000	8	4	3 1/4	1 1/4	2 1/2	8	8 1/4	9 3/4	5 1/4	2	
14000	8	4 1/2	4 1/4	1 1/4	2 1/2	9	8 1/2	9 3/4	5 1/4	2	

\*Number of tongues. (Number of slots is one less than the number of tongues.)  
†Number of studs.

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE CA CARBON CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Manually-Operated—Automatic—Multipole—750 Volts

Capacities Based on 30-Degree Rating

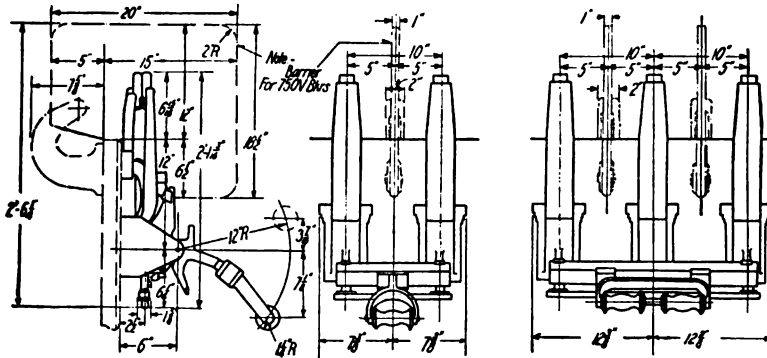


FIG. 1

400 TO 2500 AMPERES, D-C.  
400 TO 2000 AMPERES, 25 CYCLES, A-C.  
400 TO 1600 AMPERES, 60 CYCLES, A-C.

Round and Laminated Studs

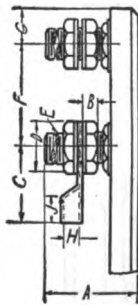


FIG. 2

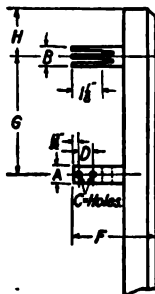


FIG. 3

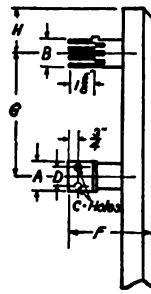


FIG. 4

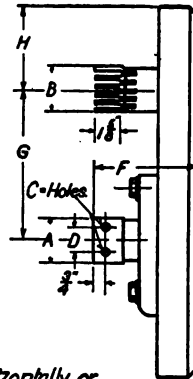


FIG. 5

Note—  
All Tongues and Slots are  $\frac{1}{8}$ "  
Either or Both Studs May Be Horizontally or  
Vertically Laminated.

D-C. Amperes	Fig.	DIMENSIONS IN INCHES								
		A	B	C	D	E†	F	G	H	J
400	2	5 1/2	1 1/2	2 1/2	1 1/4	1 1/2-11	6 3/4	2 3/4	.918	1 3/4
600	2	5 3/4	1 3/4	3 1/4	1 1/2	1 1/2-16	6 3/4	2 3/4	1.28	1 1/2
800	2	5 3/4	1 3/4	2 1/2	1 1/2	1 -14	6 3/4	2 3/4	†.918	1 1/2
1000	2	5 3/4	1 3/4	...	1 1/2	1 -14	8	3	.....	...
1200	2	5 3/4	1 3/4	...	2 1/2	1 1/2-14	8	3	.....	...
1600	2	6 1/2	1 3/4	...	2 1/2	1 1/2-14	8	3	.....	...
2000	2	6 1/2	1 3/4	...	3	1 1/2-12	8	3	.....	...

†Two terminals per stud.  
‡Diameter in inches and number of threads per inch.

D-C. Amperes	Fig.	DIMENSIONS IN INCHES								
		A	B	C	D	E*	F	G	H	I†
1600	3	1 1/2	1 1/4	1 1/4	1 1/4	3	5 1/2	7 1/2	3 1/4	1
2000	3	1 3/4	1 1/4	1 1/4	1 1/4	3	5 1/2	7 1/2	3 1/4	1
2500	4	2	1 1/4	1 1/4	1 1/4	4	5 1/2	8	3	1
3000	5	2 1/2	2 1/4	1 1/4	1 1/4	5	6 1/2	9 1/2	5 1/4	1
4000	5	3	2 3/4	1 1/4	1 1/4	6	6 1/2	9 1/2	5 1/4	1
6000	5	4	2 3/4	1 1/4	2	8	7 1/2	9 1/2	5 1/4	1
8000	5	4 1/2	4 1/4	1 1/4	2 1/2	9	7 1/2	9 1/2	5 1/4	1
10000	5	4	3 3/4	1 1/4	2	8	8 1/2	9 1/2	5 1/4	2
14000	5	4 1/2	4 1/4	1 1/4	2 1/2	9	8 3/4	9 1/2	5 1/4	2

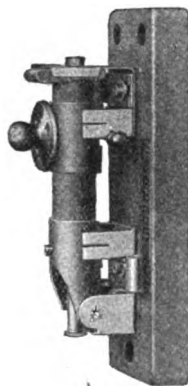
\*Number of tongues. (Number of slots is one less than the number of tongues.)  
†Number of studs.

For higher capacities use single-pole units spaced as below connected through a common trip.

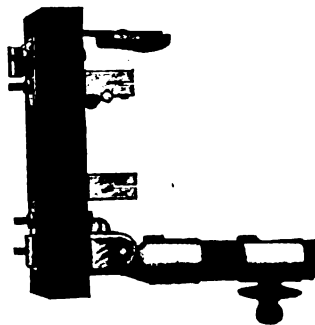
Amperes	3000	4000	6000	8000	10000	14000
Inches	18	13	16	18	20	24

These dimensions are for reference only. For official dimensions apply to nearest district office.

## TYPE F CARBON CIRCUIT-BREAKERS



Front-Connected, Closed  
TYPE F CARBON CIRCUIT-BREAKERS WITH AUTOMATIC OVERLOAD TRIP



Rear-Connected, Open  
TYPE F CARBON CIRCUIT-BREAKERS WITH AUTOMATIC OVERLOAD TRIP



TYPE F NON-AUTOMATIC  
BREAKER WITH SHUNT TRIP

The type F single-pole carbon breakers are small and compact. They readily take the place of switches and fuses and occupy about the same space as a fuse block and fuse. They are designed as a protective device to be used with small motor and lighting installations, and have a cost commensurate with those of such systems.

By installing a type F breaker for each wire of the circuit the line switch may be dispensed with and the circuit operated by means of the breakers alone. In this case the breakers cannot be closed on overloads, the breaker on one side of the circuit opening when an attempt is made to close the breaker on the other side of the circuit. The cost of such an installation is about the same as that of the switch and fuses for the same service, and there is no maintenance cost for replacing fuses.

**Limitations**—The type F carbon breakers are not satisfactory for use with polyphase motors, as they cannot be mechanically inter-connected and, therefore, would not afford full protection to such motors. For such service, interlocked three-pole or four-pole breakers, as required, should be selected.

These breakers are not satisfactory for mounting directly on machinery or in any other location where they will be subjected to considerable vibration, or for any service where they will be subjected to rough usage.

**Capacities**—These breakers are supplied for voltages up to 250 and normal current capacities of  $12\frac{1}{2}$ , 25, 50, and 75 amperes.

### Distinctive Features

Among the features that make the type F carbon circuit-breakers especially adapted to their class of service are compactness, neatness, simplicity, self cleaning contacts and use of carbon secondary or arcing contacts.

### Construction

**Operating Mechanism**—The overload-operating solenoid is inside of a fibre tube forming the lever arm. The tripping point may be set for any current within the tripping range by a knurled thumb screw located below the pivot. A small insulating knob controls the tripping device and offers a means of opening the breaker by hand.

The current-carrying contacts are copper. The arcing contacts are carbon and are readily renewable. The lever arm is operated by a spring and the copper contacts are of a shape to assist in opening the breaker.

**Automatic Overload With Shunt Trip**—By the addition of a shunt-trip coil, the type F circuit-breaker can be tripped electrically. The shunt trip does not interfere with the overload trip and the one circuit-breaker affords protection from overloads and in addition permits opening the circuit from a distance or by an automatic device. This type of breaker is shipped mounted on a slate base.

These breakers are applicable to any installation where it is desired to open the circuit by means of a push button, a contact-making relay, a contact-making voltmeter, a speed-limit mechanism, a tank float, or, in fact, any equivalent contact-making device.

**Non-Automatic With Shunt Trip**—In construction and general appearance these breakers are similar to the standard automatic-overload-trip breakers, with the exception that a spring cutout is added for the purpose of opening the trip-coil circuit when the breaker opens. This cutout is located behind the main barrel or tube of the circuit-breaker and its action eliminates any possibility of the burning out of the trip coil.

**TYPE F CARBON CIRCUIT-BREAKERS—Continued**

**Auxiliary Tripping Attachments**

Automatic overvoltage-trip, and automatic reverse-current-and-underload-trip attachments may be applied to any standard type F carbon circuit-breaker, either front or rear-connected. Either of these attachments may also be applied, without interference with existing mechanism, to type F breakers equipped with standard shunt-trip attachments.

**Mounting**—When these attachments are mounted

with a breaker on a front-connected base, it will be necessary to supply a wider base than is furnished with the standard breaker. When the breaker and attachment are mounted on a switchboard, no base is supplied and the apparatus is mounted directly on the panel. Drilling plan will be supplied on request.

**Connections**—Westinghouse-Frankel Solderless Connectors can be supplied for these breakers. For prices see section on Westinghouse-Frankel Connectors.

**PRICES**

**CIRCUIT-BREAKERS**

Style number and list price include breaker complete with base and terminals.

**With Automatic Overload Release**

Capacity Amperes	Range of Overload Adjustment Amperes	APPROX. WT., LBS.		FRONT-CONNECTED		REAR-CONNECTED	
		Net	Boxed	Style No.	List Price	Style No.	List Price
5	4-8	2	4	154713	\$26 00	154714	\$27 00
12.5	10-20	2	4	43670	26 00	88823	27 00
25	20-40	2	4	43671	26 00	88824	27 00
50	40-80	2	4	43672	26 00	88825	27 00
75	60-120	2	4	43673	26 00	88826	27 00

**With Automatic Overload Release and Shunt Trip**

Capacity Amperes	Range of Overload Adjustment Amperes	APPROX. WT., LBS.		STYLE NO. (FRONT-CONNECTED)		List Price
		Net	Boxed	110 Volts D-C.	220 Volts D-C.	
5	4-8	5	8	154715	154716	\$65 00
12.5	10-20	5	8	101292	101296	65 00
25	40-80	5	8	101293	101297	65 00
50	40-80	5	8	101294	101298	65 00
75	60-120	5	8	101295	101299	65 00

**Non-Automatic Breaker With Shunt Trip**

Capacity Amperes	RANGE OF TRIPPING VOLTAGE		APPROX. WT., LBS.		Style No. Front-Connected*	List Price
	D-C.	A-C.	Net	Boxed		
75 or Less	20-50	30-80	2½	4½	133892	\$58 00
75 or Less	50-130	80-230	2½	4½	129224	58 00
75 or Less	130-250	230-440	2½	4½	133893	58 00

\*Furnished at same price rear-connected for remounting on a 1 to 1½-inch panel, if so specified in order.

**ELECTRICALLY OPERATED ACCESSORIES**

Style number of the mechanism includes the device complete with the necessary contact nuts, terminals, mounting screws for 1-inch to 1½-inch panel and necessary terminal clips, resistance (when

required) and spring cut-out for opening the shunt coil circuit when the breaker is tripped. The style number, however does not include the base or breaker proper, which must be ordered separately.

**Overvoltage Trip**

Tripping Range Volts	APPROX. WT., POUNDS		Style No.	List Price
	Net	Shipping		
10 to 20	2½	3½	133735	\$63 00
20 to 40	2½	3½	133739	63 00
35 to 70	2½	3½	133740	63 00
65 to 130	2½	3½	133741	63 00
125 to 250	5	6 (with resistance)	133742	63 00

NOTE—If desired for use on alternating-current circuits, the voltage and frequency of the tripping coil circuit must be specified on the order.

**Reverse-Current and Underload Trip for Direct-Current Circuits**

Rated Amperes of Circuit-Breaker	Rated Voltage of Trip Mechanism	No. of 2-Volt Cells in Series	APPROX. WEIGHT, LBS.		Style No.	Style No. of Resistance	List Price
			Net	Shipping			
12½	32	16	3½	4	129225	None	\$44 00
25	32	16	3½	4	129226	None	44 00
50	32	16	3½	4	129227	None	44 00
75	32	16	3½	4	129228	None	44 00
12½	55	28	3½	4	133407	None	45 00
25	55	28	3½	4	133408	None	45 00
50	55	28	3½	4	133409	None	45 00
75	55	28	3½	4	133410	None	45 00
12½	110	56	3½	4	129229	None	50 00
25	110	56	3½	4	129230	None	50 00
50	110	56	3½	4	129231	None	50 00
75	110	56	3½	4	129232	None	50 00
12½	220-110	..	5½	6½	129229	186470	55 00
25	220-110	..	5½	6½	129230	186470	55 00
50	220-110	..	5½	6½	129231	186470	55 00
75	220-110	..	5½	6½	129232	186470	55 00

For any given value of current at any special voltage under 150 use the list price of next higher voltage unless ordered in quantities of 25 or more at one time, in which case the additional charge may be omitted.

Order by Style Number

## APPLICATION OF OIL CIRCUIT-BREAKERS

The selection of an oil circuit-breaker for application to an electrical system or circuit requires a knowledge of the characteristics of the breaker and the characteristics of the system or circuit. Breakers are usually classified according to their rated voltage, rated current, rated frequency, interrupting capacity, and instantaneous-current capacity.

Systems may be classified according to their normal operating voltage, normal current, normal frequency, and current transients. The following data gives a short description of the method of applying the information given in the following tables. For a complete description and examples of the application of oil circuit-breakers and the determination of short-circuit currents see "Switchboard Data Book."

The **interrupting capacity** of an oil circuit-breaker is the highest current in root-mean-square amperes, which it will interrupt at any specified normal pressure, frequency, and duty. This conforms with the standards adopted by the American Institute of Electrical Engineers as given in Section 7060 of the standardization rules, dated April, 1921.

The duty on which the ampere tables herewith have been based, assumes that the breaker will interrupt a circuit twice at a two-minute interval and then be in condition to be closed and carry its rated current until it is practicable to inspect it and make any necessary readjustments. This definition of interrupting capacity selects the most common condition of oil circuit-breaker operation. In so doing, it places a definite limit upon the rating of the breaker. Breakers may, however, be otherwise rated for different definitions of interrupting capacity or duty. If, for example, the breaker is required to perform one successful interruption, it may be rated higher than it would if called upon to perform two successful interruptions at a two-minute interval. Also, if the breaker is required to perform ten successful interruptions at one-half minute intervals, it will be rated lower than if called upon to perform two successful interruptions at a two-minute interval.

The **tables of short-circuit characteristics**, as published herein, may be used to determine the application of oil circuit-breakers under average conditions.

**Table A** shows factors based on the total reactance of a system. The product of these factors times the normal current of the synchronous apparatus connected to the circuit gives the probable short-circuit current under average conditions.

**Table B** directly states the greatest current in amperes that can be delivered by the secondary of transformers of 3 per cent reactance; a rule is given for changing these values where transformers of other than 3 per cent reactance are used. These are safe values that may be used in the ready application of circuit-breakers, regardless of the amount of

power behind the transformers. Where a transformer has relatively high kilovolt-ampere capacity, or is applied at the end of a considerable length of line so that the equivalent reactance of the transformer is high compared to the total equivalent reactance of the system, the maximum short-circuit current in amperes may be much less than the figures given in Table B, thus allowing the application of a smaller breaker. In such cases, or in any case where close figuring is desired, the short-circuit current should be figured by the use of Table A.

The **Curves of Figs. 1 and 2** may be used in place of Table A, the factors of which are based on these curves.

**Single-Phase Short Circuits on Three-Phase Systems**—The factors in Table A and the values of curves, Figs. 1 and 2, are high enough to cover both single-phase and three-phase short circuits on three-phase ungrounded neutral systems; or where the neutral is grounded through only one machine of several feeding the system; or where the neutral is grounded through a limiting resistance.

For single-phase short circuits on solidly grounded neutral three-phase systems, the initial current is slightly higher and the sustained current is approximately 100 per cent to 150 per cent higher than the values indicated in these tables and curves. For full protection, allowance should be made accordingly in choosing a breaker for such a system.

**Single-phase and two-phase systems** will have essentially the same short-circuit characteristics as those indicated in Table A for three-phase systems and the same factors may be used with the modification stated above for solidly grounded neutral systems.

**Short circuits in cables** are not instantaneous in nature but develop gradually into dead short circuits. On such a short, a current may pass sufficient to actuate the breaker relay and develop into a dead short circuit at the time the breaker contacts open. Where full protection is required for such cases, a breaker of a rating equal to the initial value of short-circuit current shown on curves, Figs. 1 and 2, must be used.

**Tables C and D** state the interrupting capacities of the various oil circuit-breakers listed in this catalogue in terms of the maximum amperes per pole which they should be called upon to break in the arc.

**Greatest Carrying Capacity**—The values of greatest carrying capacity in Tables C and D represent the greatest current in amperes that the breaker can carry continuously for five seconds or less. In applying a breaker, after selecting one with current-interrupting capacity equal to or greater than the system-short-circuit amperes as determined from Table A, care should be taken to see that the greatest five-second carrying capacity of the breaker is also equal to or greater than the initial rush of cur-

APPLICATION OF OIL CIRCUIT-BREAKERS—Continued

rent in the system as indicated by calculation, or by the highest point of such curve in Figs. 1 and 2 as represents the reactance of the system in question.

Applications of non-automatic breakers should be based on the breaker-interrupting-capacity ratings in Tables C and D and the two-second system short-circuit characteristics in Table A, or the transformer short-circuit-ampere values in Table B. In the use of the two-second values from Table A, it is assumed that a non-automatic breaker will not be opened in less than two seconds after the occurrence of a short circuit. For quicker opening the system characteristics should be figured accordingly.

When two-pole breakers are used between line and solidly grounded neutral, without limiting resistance, they should have a voltage rating equal to the voltage between lines (delta voltage), but their interrupting capacity when so applied will be the amperes given in Tables C and D under the voltage heading equivalent to the voltage between line and neutral (58 per cent of delta voltage).

Series-trip breakers with or without inverse-time element should be applied so that the short-circuit current to which they may be subjected will not exceed either the ampere values in the columns of

interrupting-capacity, or the short time greatest-carrying-capacity values.

When definite-time element of more than one second is applied to these breakers the short-circuit current must not exceed the five-second greatest-carrying-capacity values.

In series-trip breakers, the breaker itself has considerable reactance which limits the short-circuit current that can pass through it. The table below gives these reactances in ohms for types F-10 and F-11 breakers, and types F-1 and F-3 weather-proof breakers. On three-phase grounded circuits protected by two trip coils there is one leg which will not have a trip coil in circuit, and current in this leg will not be limited. Application should be made accordingly.

Breaker Rating, Amperes	REACTANCE OF BREAKER IN OHMS		Breaker Rating, Amperes	REACTANCE OF BREAKER IN OHMS	
	25-Cycle	60-Cycle		25-Cycle	60-Cycle
2	6.75	13.45	25	0.0413	0.0818
3	2.87	5.77	30	0.0252	0.0521
5	0.972	2.08	50	0.0094	0.0196
8	0.385	0.800	70, 75	0.00518	0.0104
10	0.246	0.503	100	0.00261	0.00537
12	0.157	0.322	150	0.000912	0.00171
15	0.108	0.224	200	0.000445	0.000336
20	0.0582	0.120	300	0.000250	0.000440

When using a series-trip breaker on the secondary of a transformer this reactance should be added to the transformer reactance, and the reactance of line from transformer to breaker, as shown in the following formula:

$$\text{Short-Circuit line Amperes} = \frac{.58 \times \text{line voltage}}{\text{Transformer short-circuit amperes}} + \frac{.58 \times \text{line voltage}}{\left\{ \begin{array}{l} \text{Reactance of} \\ \text{breaker in ohms} \end{array} \right\} + \left\{ \begin{array}{l} \text{Reactance per wire of line} \\ \text{in ohms} \end{array} \right\}}$$

For example, take a 50-ampere type F-11 750-volt series-trip breaker feeding a motor from the secondary of a 300-kv-a. 2200—220-volt 60-cycle transformer having 4 per cent reactance. The short-circuit current of the transformer from Table B is 26,250 amperes for 3% reactance and 19,700 amperes for 4% reactance, at 220 volts. Assume the wires connecting the breaker to the transformer are No. 4 gauge and are 40 feet long with conductors spaced 2 inches apart. The reactance per wire is approximately 0.390 ohms per mile at 20°C; or 0.00295 ohms for 40 feet. The breaker reactance from above table is 0.0196 ohms. Substituting in above formula we have:

$$\text{Short-circuit line amperes} = \frac{.58 \times 220}{19700} + \frac{.58 \times 220}{0.0196 + 0.00295} = 4400 \text{ amperes}$$

As the 50-ampere 750-volt type F-11 circuit-breaker interrupting-capacity from Table C is 10,000 amperes at 440 volts and less, this breaker may be applied; whereas, had the reactance of the breaker not been considered, the value of 19,700 amperes capable of being delivered from the transformer would indicate that this particular breaker could not be applied to the system

All doubtful or unusual problems regarding the application of oil circuit-breakers should be referred to the Company for recommendations. Each inquiry or request for special recommendations should give information regarding the problem as follows:

- 1—Rating and number of synchronous-alternator, synchronous-motor, synchronous-condenser, and synchronous-converter units.
- 2—Rating and number of transformers and reactors.
- 3—Reactance of each unit on basis stated below under "percentage reactance."
- 4—Resistance, reactance, and capacitance of each portion of the system in ohms, or size, length, relation, and spacing of the conductors of the system.
- 5—Complete diagram of connections of the system.
- 6—Normal operating frequency of system.
- 7—Normal operating voltage of system.
- 8—Maximum permissible time between the instant the short circuit is made and the instant the short circuit must be cleared from the system.
- 9—Complete details of the proposed application.

The percentage reactance of any leg of a circuit is the reactance drop in that leg of the circuit at normal current expressed as a per cent of the voltage to the neutral of that circuit. The values listed are initial values based on a symmetrical sine wave and on the normal rating of the machines connected to the bus. The percentage reactance of alternators varies from about 5 per cent to 30 per cent. The percentage reactance of transformers varies from about 3 per cent to 20 per cent.



APPLICATION OF OIL CIRCUIT-BREAKERS—Continued

TABLE A—SHORT-CIRCUIT-CURRENT FACTORS FOR THREE-PHASE SYSTEMS

Method of Tripping Breaker Corresponding To Time Elapsed		Elapsed Time in Seconds from Time of Short Circuit†	*Reactance Based on Total Kv-a. Rating of Synchronous Machines												
			8%	10%	12%	15%	20%	30%	40%	50%	60%	75%	100%	125%	150%
			†Current Factors Expressed as Number of Times Full-Load Current												
No Relay	A-C. Series Trip Coil	.05	13.91	11.16	9.59	7.68	6.04	4.03	3.01	2.40	2.00	1.58	1.17	0.92	0.77
	Cur. Trans. with A-C. Trip Coil	.08	11.78	9.54	8.25	6.66	5.27	3.59	2.74	2.21	1.86	1.50	1.13	0.90	0.76
Solenoid or Motor Relay	Cur. Trans. with A-C. Trip Coil	.10	10.94	8.89	7.68	6.23	4.97	3.41	2.63	2.13	1.81	1.46	1.11	0.89	0.76
	Cur. Trans. with D-C. Trip Coil	.15	9.16	7.54	6.57	5.40	4.38	3.08	2.42	2.00	1.71	1.41	1.09	0.89	0.76
Induction Relay	Cur. Trans. with A-C. Trip Coil	.20	8.24	6.80	5.97	4.95	4.06	2.92	2.30	1.92	1.66	1.38	1.08	0.88	0.76
	Cur. Trans. with D-C. Trip Coil	.25	7.55	6.28	5.54	4.63	3.82	2.79	2.23	1.87	1.63	1.36	1.07	0.88	0.76
Circuit-Breakers Having A-C. or D-C. Trip With Definite-Time Setting		.30	7.03	5.88	5.19	4.39	3.67	2.70	2.18	1.84	1.60	1.34	1.06	0.88	0.76
		.40	6.27	5.30	4.74	4.03	3.40	2.57	2.10	1.79	1.57	1.32	1.06	0.87	0.76
		.50	5.74	4.91	4.40	3.80	3.23	2.48	2.04	1.75	1.54	1.31	1.05	0.87	0.76
		.70	4.99	4.34	3.93	3.45	2.98	2.34	1.96	1.70	1.51	1.29	1.04	0.87	0.76
		1.00	4.25	3.77	3.47	3.11	2.73	2.21	1.88	1.65	1.48	1.27	1.04	0.87	0.76
		1.50	3.63	3.31	3.08	2.82	2.53	2.10	1.81	1.61	1.45	1.25	1.03	0.87	0.76
		2.00	3.20	2.98	2.82	2.63	2.39	2.03	1.77	1.58	1.43	1.24	1.02	0.87	0.76

\*This includes both internal reactance of machines and reactance of external circuit reduced to the above basis. For reactance values not shown use the next lower listed reactance.

†Rated full-load current based on maximum continuous kilovolt-ampere rating of synchronous machines. When the equivalent reactance of line, reactor, transformer, or combination of these, expressed in per cent based on the total synchronous machine rating, exceeds 150 per cent, the current to be interrupted may be determined directly from that reactance. This is due to the fact that under these conditions, the generator reactance and time of opening of the breaker may be neglected.

‡If breakers are equipped with undervoltage release mechanisms use time value of .08 seconds unless such mechanism is provided with a definite-time adjustment that can be set the same as an overload relay.

TABLE B—TRANSFORMER CHARACTERISTICS  
Three-Phase Current in Secondary on Short Circuit  
Primary Pressure Assumed to be Sustained

5 to 200 Kilovolt-Amperes 3%\* Reactance

Secondary Volts	110	220	330	440	550	660	1100	2200	3300	4400	6600	11000	13200	22000	33000	44000	55000	66000	88000	110000	
Transformer Bank Rating in Kv-a.	Secondary Short-Circuit Current In Amperes																				
5	877	438	292	219	175	146	88	...	...	...	...	...	...	...	...	...	...	...	...	...	
7.5	1313	656	438	329	263	219	131	...	...	...	...	...	...	...	...	...	...	...	...	...	
10	1750	877	584	438	350	292	175	88	...	...	...	...	...	...	...	...	...	...	...	...	
15	2625	1313	877	657	525	438	263	131	88	...	...	...	...	...	...	...	...	...	...	...	
20	3500	1750	1167	877	700	584	350	175	117	88	...	...	...	...	...	...	...	...	...	...	
25	4375	2190	1460	1095	877	730	438	219	146	110	73	...	...	...	...	...	...	...	...	...	
37.5	6560	3280	2190	1645	1313	1095	656	328	219	165	110	...	...	...	...	...	...	...	...	...	
50	8770	4375	2920	2190	1750	1460	877	438	292	219	146	88	73	...	...	...	...	...	...	...	
75	13130	6560	4375	3290	2625	2190	1313	656	438	329	219	131	110	...	...	...	...	...	...	...	
100	17500	8770	5835	4375	3500	2920	1750	877	584	438	292	175	146	88	...	...	...	...	...	...	
125	21880	10950	7300	5475	4375	3650	2188	1095	730	548	365	219	183	110	...	...	...	...	...	...	
150	26250	13130	8770	6570	5250	4375	2625	1313	877	657	438	263	219	131	88	...	...	...	...	...	
200	35000	17500	11670	8770	7000	5835	3500	1750	1167	877	584	350	292	175	117	88	...	...	...	...	
200	35000	17500	11670	8770	7000	5835	3500	1750	1167	877	584	350	292	175	117	88	...	...	...	...	
250	43750	21900	14600	10950	8770	7300	4375	2190	1460	1095	730	438	365	219	146	110	88	...	...	...	
300	52500	26250	17500	13130	10500	8770	5250	2625	1750	1313	877	525	438	263	175	131	105	88	...	...	
400	70000	35000	23350	17530	14000	11670	7000	3500	2335	1753	1167	700	584	350	234	175	140	117	88	...	
500	87700	43750	29200	21900	17500	14600	8770	4375	2920	2190	1460	877	730	438	292	219	175	146	110	88	
750	...	65600	43750	32850	26250	21900	13130	6560	4375	3285	2188	1313	1095	656	438	329	263	219	164	131	
1000	...	87700	43750	35000	29200	17500	8770	5835	4375	2920	1750	1460	877	584	438	350	292	219	175	175	
1500	...	...	87700	65700	52500	43750	26250	13130	8770	6570	4375	2625	2190	1313	877	657	525	438	328	263	
2000	...	...	...	87700	70000	58350	35000	17500	11670	8770	5835	3500	2920	1750	1167	877	700	584	438	350	
2500	...	...	...	...	87700	73000	43750	21880	14600	10950	7300	4375	3650	2188	1460	1095	777	730	547	438	
3000	...	...	...	...	...	87700	52500	26250	17500	13130	8770	5250	4375	2625	1750	1313	1050	877	656	525	
4000	...	...	...	...	...	...	70000	35000	23350	17530	11670	7000	5835	3500	2335	1753	1400	1167	877	700	
5000	...	...	...	...	...	...	87700	43750	29200	21900	14600	8770	7300	4375	2920	2190	1750	1460	1095	877	

\*For transformers of other than 3% reactance, multiply the amperes given in the table above by 3 and divide the product by the per cent reactance of the transformer used.

APPLICATION OF OIL CIRCUIT-BREAKERS—Continued

TABLE C—AUTOMATIC SERIES-TRIP OIL CIRCUIT-BREAKERS

Rated Amperes	Rated Volts	Method Control	GREATEST CARRYING CAPACITY AMPERES				MAXIMUM INTERRUPTING CAPACITY IN AMPERES AT SERVICE VOLTAGES* OF					
			0.2 Second	1 Second	5 Seconds	750 V	2500 V.	4500V.	6000 V.	7500 V.	12000 V.	15000 V.
<b>Type F-11 Manually-Operated Series Trip Automatic Overload Breakers</b>												
5-200	750	D. & R.	100†	50†	25†	10000	.....	.....	.....	.....	.....	
<b>Type F-10 Manually-Operated Series Trip Automatic Overload Breakers</b>												
5-200	2500	D.	100†	50†	25†	10000	3000	.....	.....	.....	.....	
300	750	D.	100†	50†	25†	12200	.....	.....	.....	.....	.....	
<b>Type F-1 Manually-Operated Single-Throw Weatherproof and Subway</b>												
10-200	7500	D.	100†	50†	25†	10000	3400	1800	1270	960	.....	
300	7500	D.	100†	50†	25†	15000	3400	1800	1270	960	.....	
5-200	4500	D.	100†	50†	25†	10000	3300	1600	.....	.....	.....	
5-200	750	D.	100†	50†	25†	10000	.....	.....	.....	.....	.....	
300	750	D.	100†	50†	25†	15000	.....	.....	.....	.....	.....	
<b>Type F-2 Electrically-Operated Single-Throw Subway</b>												
5-200	7500	E.	100†	50†	25†	10000	6100	3200	2250	1700	.....	
300	7500	E.	100†	50†	25†	15000	6100	3200	2250	1700	.....	
<b>Type F-3 Manually-Operated Single-Throw Weatherproof</b>												
5-200	15000	D.	100†	50†	25†	10000	10000	5600	4130	3200	1850	
10-200	7500	D.	100†	50†	25†	10000	10000	5400	3950	2900	.....	
300	7500	D.	100†	50†	25†	15000	10400	5400	3950	2900	.....	
500†	7500†	D.	25000†	25000†	..	25000	10400	5400	3950	2900	.....	
600†	7500†	D.	30000†	30000†	..	30000	10400	5400	3950	2900	.....	
800†	4500†	D.	40000†	40000†	..	35900	9800	4800	.....	.....	.....	

TABLE D—NON-AUTOMATIC AND AUTOMATIC TRANSFORMER-TRIP OIL CIRCUIT-BREAKERS

	5-Seconds		750	2500	4500	6000	7500	12000	13200
			volts	volts	volts	volts	volts	volts	volts
<b>Type I Manually-Operated Single and Double-Throw Non-Automatic Indoor</b>									
60	4500	D.	2000	1000	610	300	.....	.....	.....
<b>Type D Manually-Operated Single and Double-Throw Non-Automatic Indoor and Outdoor</b>									
200	4500	D. & R.	5000	5000	1630	800	.....	.....	.....
300	7500	D. & R.	10000	5000	2500	1300	940	700	.....
200	15000	D.	5000	5000	5000	2840	2080	1600	940
<b>Type F-11 Manually-Operated Single and Double-Throw Automatic and Non-Automatic Indoor</b>									
200	4500	D. & R.	10000	10000	6500	3200	.....	.....	.....
400	2500	D. & R.	20000	20000	6500	.....	.....	.....	.....
<b>F-22 Manually and Electrically-Operated Automatic and Non-Automatic Indoor</b>									
400	7500	D. & R.	20000	20000	9000	4700	3300	2500	.....
600	7500	D. & R.	30000	30000	9000	4700	3300	2500	.....
800	2500	D. & R.	40000	32000	9000	.....	.....	.....	.....
<b>Type F-22 Manually and Electrically-Operated Multiple Single-Pole Indoor</b>									
400	7500	D. & R.	20000	20000	10400	5400	3850	2900	.....
600	7500	D. & R.	30000	30000	10400	5400	3850	2900	.....
800	2500	D. & R.	40000	37000	10400	.....	.....	.....	.....
<b>Type F-33 Manually and Electrically-Operated Multiple Single-Pole Indoor</b>									
400	15000	R.	20000	20000	14300	7800	5600	4400	2520
600	15000	R.	30000	30000	14300	7800	5600	4400	2520
800	15000	R.	40000	40000	14300	7800	5600	4400	2520
<b>Type QF Manually-Operated Indoor</b>									
300	7500	D. & R.	15000	15000	8600	4500	3200	2400	.....
600	4500	D. & R.	25000	25000	8600	4500	.....	.....	.....

\*To obtain interrupting capacity at any intermediate service voltage:

- Let A=Service voltage proposed.  
 B=Next higher service voltage in table.  
 C=Amperes interrupting capacity in table at voltage "B."  
 D=Amperes interrupting capacity at voltage "A."  
 E=Amperes interrupting capacity at the lowest voltage at which the breaker is rated in the table.  
 F=Limit of current to be admitted to series trip coils as given in the table.  
 Then  $D = \frac{B \times C}{A}$  (See Note 1)

NOTE 1:—If value so calculated for "D" exceeds that given for "E" or "F," then "E" or "F" must be used as interrupting capacity of breaker at "A" or any lower voltage.

The carrying capacity of series trip coils may prevent taking full advantage of interrupting capacity of breaker. (See also application rules for series-trip breakers on previous page.)

†Number of times coil rating. ‡Amperes.

‡These are transformer-trip breakers with self-contained transformers.

†D = Direct-control panel or panel-frame mounting, R. = Remote-control manually-operated, E = Remote-control electrically-operated. Non-automatic manually-operated remote-control breaker ratings are the same as the direct-control breaker ratings.

APPLICATION OF OIL CIRCUIT-BREAKERS—Continued

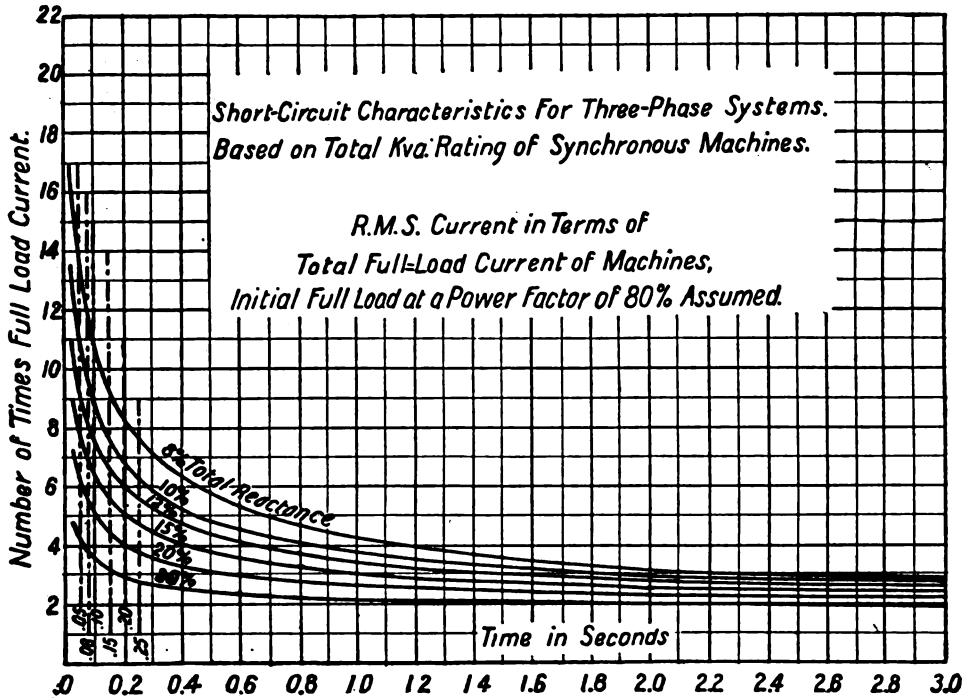


FIG. 1—SHORT-CIRCUIT CHARACTERISTICS FOR THREE-PHASE SYSTEMS BASED ON TOTAL KILOVOLT-AMPERE RATING OF SYNCHRONOUS MACHINES

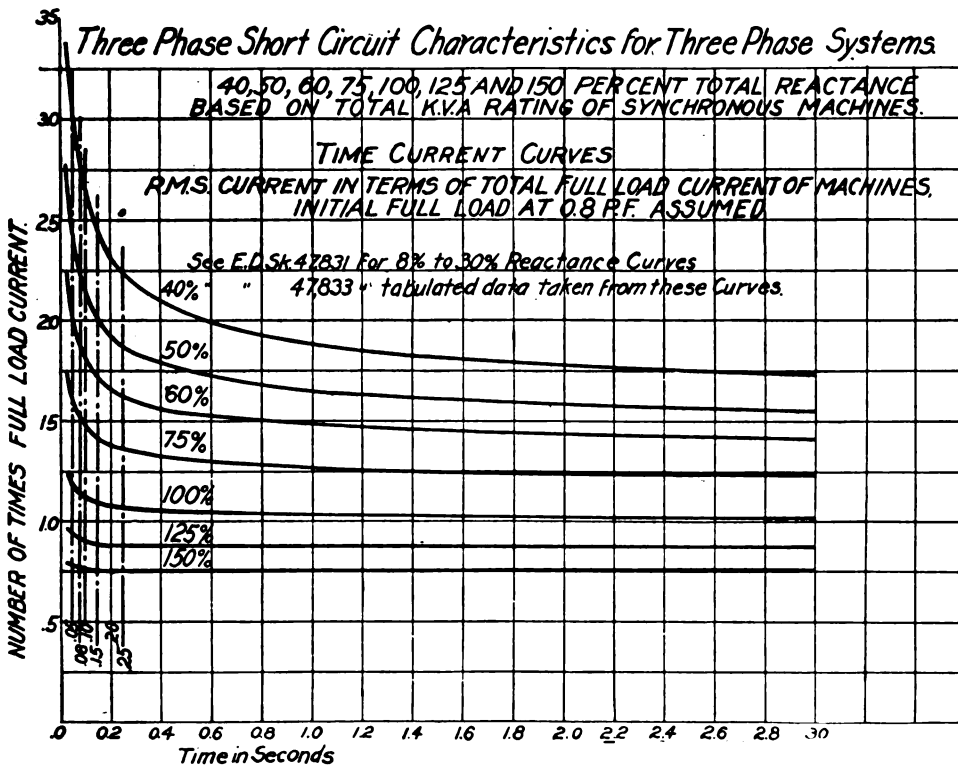


FIG. 2—SHORT-CIRCUIT CHARACTERISTICS FOR THREE-PHASE SYSTEMS BASED ON TOTAL KILOVOLT-AMPERE RATING OF SYNCHRONOUS MACHINES

## OIL CIRCUIT-BREAKERS—GENERAL INFORMATION

The oil circuit-breaker affords the best insurance against costly interruption of service. The breaker operation is positive, but, in the case of automatic overload breakers, can be adjusted to trip between wide limits of either breaker or relay calibration.

### Single-Throw

The data given in this section, unless otherwise specified, applies to single-throw breakers.

### Double-Throw

Double-throw breakers, where not listed, can be supplied on special orders, as follows: (Prices will be quoted on request).

**Manually-operated** double-throw circuit-breakers (downward-pull wall or pipe-mounting remote-control with bell cranks above or below the floor) are made up of any combination of two separate single-throw circuit-breakers operated from one two-handle cover-plate. The two-handle cover-plate is supplied with a simple interlocking device so that only one throw can be closed at a time. The interlocking de-

vice can be omitted on special order, thus permitting the transfer of a circuit without opening. Either or both throws of the double-throw circuit-breaker can be made automatic or non-automatic, as ordered, and when automatic can be equipped with under-voltage, overload or inverse-time-element attachment. All of the accessories specified for use with single-throw circuit-breakers (except triple-coil cover-plates) can be used on the double-throw circuit-breakers.

For **electrically-operated** double-throw circuit breakers, two single-throw breakers are used with wiring interlocked. The electrical interlocking of the control wiring should be made by means of a special five-point drum control switch.

### Special Breakers

It is desirable to make projects covering circuit-breakers differing from standard as described and listed, the subject of special negotiation and correspondence with the Company.

## CURRENT RATING, TEMPERATURE AND ALTITUDE EFFECT

The rated current of a circuit-breaker is the greatest current in r. m. s. amperes which it will carry continuously at a specified frequency without any essential part having its temperature raised more than a specified number of degrees above an ambient temperature, or above a fixed temperature.

The American Institute of Electrical Engineers has established heating standards for oil circuit-breakers. These are given in Sections 7101 and 7301 of the supplement to the Standardization Rules dated April, 1921. They limit the maximum permissible temperature rise of coils and insulating materials of oil circuit-breakers to 70 degrees Centigrade, based on an ambient temperature of 40 degrees Centigrade, and the rise of other parts, whose temperature does not affect the temperature of the insulating material, to be such as not to be injurious in other respects. They also limit the maximum temperature of oil and contacts in oil to 70 degrees Centigrade. For an ambient temperature of 40 degrees Centigrade, this permits a temperature rise of 30 degrees Centigrade for oil and for contacts in oil. Where, however, the ambient temperature is less than 40 degrees Centigrade, advantage may be taken of the condition to operate the parts at a higher temperature rise if the maximum temperatures specified are not exceeded. The breakers listed herein are rated on ambient temperatures of 40 degrees Centigrade and comply with the standards adopted by the American Institute of Electrical Engineers.

To determine the ambient temperature of reference for breakers mounted in cells or other places when the tempera-

ture about the breaker varies considerably, take the average of the following three thermometer readings: one reading one foot below the breaker tanks, one reading one foot above the breaker terminals and a third reading midway vertically between the first two, and not more than one foot away from the breaker frame.

**Altitude**—Standard ratings of Westinghouse oil circuit-breakers apply for altitudes of 3300 feet above sea level and less. For higher altitudes, standard listed breakers must be used on voltages and currents less than their rating, the amount of this derating depending on the altitude.

**Voltage Derating**—For operation at altitudes greater than 3300 feet above sea level the voltage rating given must be multiplied by the following factors.

Distance above Sea Level in Feet	Voltage Rating Factor
4000	0.98
6000	0.92
8000	0.86
10000	0.81
12000	0.76
14000	0.72

**Current Derating**—For operation at altitudes greater than 3300 feet above sea level the current (ampere) ratings given must be multiplied by the following factors.

Distance above Sea Level in Feet	Voltage Rating Factor
4000	0.98
6000	0.92
8000	0.86
10000	0.79
12000	0.74
14000	0.66

## METHODS OF OPERATION

### Manual Operation

Manual closing from a coverplate lever or handle on a panel or frame bracket is the ordinary method of closing small or medium sized circuit-breakers both panel-mounting and remote-control.

All Westinghouse automatic overload-trip manually-operated circuit-breakers are known as full-automatic (trip free on overload); the tripping details being so designed that it is impossible to latch the circuit-breaker closed when excessive overload or short circuit exists on any phase of the line. To accomplish this, two levers are provided one being placed within the other. The outer lever is fastened to the operating handle; the inner lever is connected to the mechanism of the circuit-breaker proper. Under normal conditions, the levers move together due to a trigger on the outer

lever being engaged with the inner lever. The trigger is acted upon directly by the tripping coil plungers. If an overload or short circuit should come on the line the tripping coil core releases the trigger allowing the inner lever to return to the upper position, thus opening the breaker. It is necessary for the operating handle to be returned to the upper position for latching with the inner lever before the circuit-breaker can again be closed.

The **manual remote-control** method of operation is subject to the following limitations:

(a) With bell cranks mounted either above or below the floor, the distance between the handle and the breaker units should not exceed 50 feet.

(c) The friction interposed by a complicated system of bell cranks and rods must not be such as to prohibit the quick operation of the circuit-breaker.

## OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

The control or operating rods should be of three-quarter-inch gas pipe and, except in lengths of 6 feet or less, should be operated in tension during the closing operation of the breaker. Vertical rods should be arranged, if possible, so that the weights are balanced.

When distances are too great (in general when the total length of the operating rods exceeds 50 feet) the weight of the rods and the friction in the standard mechanism may offer so much resistance to the proper operation that it will be necessary to install special operating devices. Such cases should be referred to the Company.

When horizontal pipes exceed 20 feet in length an intermediate support should be provided.

Where distance between switchboards and switching devices makes the application of hand-operated breakers questionable, electrically-operated breakers should be supplied. Doubtful cases should be referred to the Company.

### Electric Operation

In the field of power-operated circuit-breakers the Westinghouse Electric and Manufacturing Company has long maintained as standard, the electric-solenoid method of closing, which is now used almost universally to the exclusion of various other methods, such as motor, hydraulic, and pneumatic power. The electric-solenoid type of operation is very flexible and permits mounting the operating mechanism on cell walls, on pipe frames, or on the floor, above, below, or behind the circuit-breaker. Each type of breaker will, however, regularly employ one or more arrangements that will be standard. **Special arrangements will involve increased costs and time of delivery.** The individual mechanism arrangements are shown in Figs. 115 to 118.

Electric-operating mechanisms are usually provided with an **accelerating attachment**, to insure speedy opening of the contacts on tripping.

**Control Circuit**—Standard electric-operating (closing and tripping) mechanisms are made for direct-current operation. This form, besides utilizing simpler construction, being more reliable in operation and more easily kept in repair, is much more economical of space and power than alternating-current mechanisms. For special applications such as for alternating-current electrically-operated railway sectionalizing circuit-breakers and other installations where no auxiliary source of direct-current power is available, special alternating-current operating mechanisms can be supplied; prices on request. Their evident disadvantages, however, make their general use undesirable.

With inquiries, contemplating alternating-current control, submit full details for the installation contemplated, particularly the characteristics of the circuits supplying the power for the control circuits.

**Mechanism**—The standard electric mechanism closes the breaker by a direct-current magnet and

holds it closed by a latch and trigger which engage automatically. The tripping mechanism consists of a direct-current trip magnet acting on a trigger, which releases the latch, permitting the breaker to open.

The closing and tripping mechanism is operated by a **control switch**, with or without control relays (switches) in the closing circuit, and usually with **signal lamps** as described on pages on "Switchboard Accessories."

All electric operating mechanisms have a small **double-throw switch** to open the shunt-trip coil circuit when the circuit-breaker opens and to operate the signal circuit (lamps). See Figs. 76 to 80 for diagrams.

The standard electric mechanisms are regularly supplied with **closing solenoids** wound for 90 to 140 volts (125 volts nominal) direct current. The time required to close a breaker from the time of the closing of the control-switch contacts until the arcing contacts in the breaker touch, is 3/10 to 6/10 seconds. Coils for other than the aforementioned standard voltages, or of greater operating range, can be supplied upon special order; prices on request.

The electric mechanisms are equipped with **tripping coils**, as standard, to operate at from 70 to 140 volts direct current.

Electric operating mechanisms can be furnished at the same price as those described but with closing coils to operate at from 180 to 280 volts, direct current, or to trip at from 140 to 280 volts, direct current.

Trip coils of other than the standard voltage, or of greater operating range, or mechanisms for operation on 110, 220, 440, or 550 volts, 25 or 60-cycle alternating current, can be supplied on special order; prices on request.

**Manual closing**—The electrically-operated breakers can be closed manually by a handle inserted in a socket on the electric operating mechanism or breaker mechanism.

### Summary of Methods of Operation Available

Type of Breaker	Direct Control Manual	REMOTE CONTROL	
		Manual	Electrical
I	Yes	No	No
D	Yes	Yes	No
F-10	Yes	No	No
QF	Yes	Yes	No
F-11	Yes	Yes	No
F-22	Yes	Yes	Yes
F-33	Yes	Yes	Yes

### Acceleration

One of the prime necessities in oil circuit-breaker operation is that when the contacts have commenced to separate they shall travel rapidly, especially during the first part of the stroke. Speed of operation reduces the duration of the arc, reduces the amount of energy expended in the arc, reduces the

## OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

volatilization of metal parts and oil, and, consequently, reduces the tank pressure which is a determining factor in the ultimate capacity rating of a breaker. All small automatic circuit-breakers are provided with accelerating springs in the breaker itself; this insures speedy operation when the switch is unlatched. Automatic overload-trip remote-control circuit-breakers in smaller sizes are provided

with accelerating devices mounted on one of the remote control bell cranks. This device precludes any possibility of the sticking of the circuit-breakers, when tripped, in case the system of remote-control rods and cranks is arranged so that they overbalance the weight of the circuit-breaker contacts; it also insures a rate of acceleration of moving parts greater than that due to unassisted gravity.

## METHODS OF TRIPPING

See schematic diagrams on following pages

## Non-Automatic Trip

**Manually-operated** circuit-breakers supplied for non-automatic operation are tripped by hand from the face-plate or breaker mechanism.

**Electrically-operated** circuit-breakers supplied for non-automatic operation are supplied with a direct-current shunt tripping magnet acting on a trigger that releases the latch. The shunt-tripping magnet is usually energized by a circuit controlled from some central point, or it may be connected to a relay circuit, thus giving automatic features through the relays.

When direct current is not available for operating the standard shunt-tripping magnet, special magnets usually can be supplied for using alternating current; price on request.

## Automatic Overload Trip

**Plain-automatic overload-trip** circuit-breakers when closed with an overload on the line will remain closed as long as the closing coil (of electrically-operated breakers) is energized, or the manually operated mechanism is held in the closed position. With electrically-operated breakers, when the closing-coil circuit is opened, the breaker will not remain closed on overloads.

**Full-automatic overload trip** circuit-breakers have a mechanism as described under the heading "Methods of Operation," making it impossible to hold the breaker in a closed position while a continuous overload condition or short circuit exists on the circuit.

**Tripping from Current Transformers**—For manually-operated circuit-breakers, direct tripping from the secondary of current transformers is the most common method of automatic-overload tripping where no time element feature is necessary. (See Figs. 12 to 26 and 48 to 75). For some low-voltage indoor circuit-breakers, series-trip overload coils can be used, mounted directly on the circuit-breaker. (See heading "Tripping from Series Coils", and Figs. 1 to 11).

Where time-limit features are wanted, inverse time-limit dashpots are supplied on some types of Westinghouse circuit-breakers, or relays having this feature may be used.

For electrically-operated circuit-breakers, tripping from the secondary of current transformers is most common. This tripping can be accomplished by connecting the secondaries directly to the current trip coils of the circuit-breaker, or by connecting them to relays which operate the current trip coils or shunt trip coils. Series automatic-overload trip coils can also be used on some of the Westinghouse electrically operated circuit-breakers.

The coils for current-transformer automatic-overload trip are mounted on the cover-plate or on the breaker mechanism of the manually-operated circuit-breakers, and on the operating mechanism of electrically-operated circuit-breakers. A single 5-ampere coil is regularly used on single-pole and two-pole circuit-breakers, and two 5-ampere coils on three-pole and four-pole circuit-breakers.

On two and three-phase ungrounded systems, two current transformers connected to two 5-ampere coils (Figs. 17 and 23) are recommended for overload protection.

On four-wire three-phase grounded-neutral circuits, three current transformers connected in "Z" to two 5-ampere coils are recommended for automatic overload protection. (See Fig. 20.)

On balanced ungrounded two or three-phase circuits one current transformer and one 5-ampere trip coil can be used for automatic overload protection. (See Figs. 16 and 22).

For three-phase reverse-power protection, three current transformers are necessary, and, when these are connected through reverse-current relays directly to current trip coils, three 5-ampere coils are necessary. (See paragraphs on "Direct-Trip Attachment," also under the heading "Small Oil Circuit-Breaker Accessories.") Triple-coil overload tripping can usually be supplied on special order; price on request.

Ordinarily, where current transformers are used for instruments and watt-hour meters, the trip coils can be connected to the same transformers, if great accuracy is not required. Where not required for instruments or meters, lower priced transformers of good accuracy are available for connection directly to the circuit-breaker trip coils or to relays. For descriptions of current transformers see Section

## OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

3-B on "Westinghouse Instruments and Relays" and data under the heading "Small Oil Circuit-Breaker Accessories."

**Tripping from Series Coils**—The coils for series automatic-overload trip are either dry insulated, mounted on the switchboard coverplate, or they are contained in the circuit-breaker oil tank. In the former case, the main connections to the series trip coils are made through holes in the panel; these holes being covered by the coverplate. This method of trip is recommended to be applied only to small low-capacity installations, not having current transformers for meters. (See Figs. 1 to 11 for connections.)

**Tripping Calibration**—Breakers automatically operated from current transformers and current-transformer trip coils or from series trip coils are calibrated to function through a range of from 100 to 180 per cent of the normal current rating of the current transformer or of the series trip coil, except the type F-33 breaker which is calibrated from 80 to 160 per cent of normal current rating unless otherwise specified. The tripping coils can be set to function at any current within the range given on the scale by means of an adjusting screw at the bottom of the coil. Since the transformer trip coils are energized by power from the secondaries of series transformers in the main circuit, the high voltage is removed from the coverplate (and therefore from the front of switchboard panel or other operating station).

**Inverse Time Limit**—When inverse time limit is required to prevent the circuit-breaker coming out unnecessarily on short overloads, an adjustable inverse-time-limit dashpot can be applied to the standard coverplate of some breakers. With various mixtures of oil, the time limit can be varied considerably. For time characteristics using oil furnished with the attachment, see information under the various types of breakers.

With other breakers the inverse-time-limit dashpots are located in the breaker tank and operate in the breaker oil thus eliminating the possibility of using various oil mixtures.

**Relays**—Where a more reliable time limit is required for selective operation of circuit-breakers than can be provided by the type of dashpot described above, protective relays should be used in connection with the circuit-breaker trip coils. For description and connection diagrams of the selective protection possible with relays, see Section 3-B on "Westinghouse Instruments and Relays." The use of relays and transformers in connection with an auxiliary source of direct current for tripping obviates the use of overload coils and the dashpot time-limit feature on circuit-breaker or cover-plate.

**Direct-Trip Attachment**—The direct-trip attachment is a retaining coil which prevents the tripping plunger from acting to trip the circuit-breaker until the relay (contact-closing type) operates. This device requires no shunt-trip circuit and is applicable where no reliable direct-current or alternat-

ing-current shunt-trip power is available. For lists of direct-trip attachments see pages on the various types of breakers. Connection diagrams will be furnished on request.

### Tripping Attachments

The tripping arrangements described in the following paragraphs can usually be provided.

**Automatic Undervoltage**—Where automatic undervoltage protection is required, or where tripping is desired upon failure of power rather than from an auxiliary circuit, an automatic undervoltage trip can be supplied. Up to 600 volts alternating current the coil of this attachment is shunted directly across the line, but on higher voltages the coil is connected in the secondary of a voltage transformer as shown in Figs. 110 to 106.

To prevent the burning out of the coil, due to open magnetic circuit, the automatic retrieve undervoltage mechanism provides for the automatic retrieving of the plunger to its original position upon the opening of the circuit-breaker. With this arrangement, the coil must be connected on the incoming line, for otherwise the circuit-breaker cannot be closed, as the undervoltage attachment will trip the circuit-breaker before the contacts come together. When, however, a hand-operated circuit-breaker controls a high-voltage line, and excitation for the undervoltage coil is obtained from the low-voltage side, then the plunger must be retrieved by hand, or automatically when closing the circuit-breaker, as the closing of the circuit-breaker is necessary to put voltage on the coil. When electrically-operated circuit-breakers are used for this kind of service, a separate automatic retrieving mechanism is used, operating jointly with the circuit-breaker closing operation for returning the undervoltage plunger to its normally closed position.

**Automatic Underload**—The automatic undervoltage trip attachment as described above can be supplied with a 5-ampere coil and then used as an automatic underload-trip device in connection with appropriate current transformers to trip the circuit-breakers upon the load decreasing below a predetermined amount. These are of the manual-reset form.

**Automatic overvoltage** trip coils can be used on Westinghouse circuit-breakers to trip the breaker in case the voltage of the circuit increases to a certain predetermined setting.

### Tripping Combinations

On most hand-operated Westinghouse circuit breakers, when a double-coil, or a triple-coil coverplate is used, either a shunt trip or an overvoltage-trip coil, or both, can be added on special order in the place ordinarily occupied by one or more of the overload coils. The overload may be equipped with dashpot or direct trip when desired.

**OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued**

The undervoltage trip is a separate mechanism and can be used with any arrangement of overload or overvoltage trip. The undervoltage and under-load trips are the same mechanisms with different coils so that generally both cannot be used on the same breaker.

On most breakers the electric lock-out device can be supplied in addition to the undervoltage trip coil. In some cases the electric lock-out and undervoltage trip are combined into one device.

**CONSTRUCTION**

The construction of all breakers is such that the entire breaker may be assembled, lined up, and the contacts adjusted before the tanks are placed in position. This feature of accessibility is a decided advantage in securing quick and accurate repair and adjustment. In breakers having separate pole units, a pole unit can be quickly removed and an-

other substituted, thus re-establishing service in a minimum of time.

Instruction books for installing and operating are supplied with all breaker shipments. These books should be carefully read and the instructions followed to obtain the best operating results.

**TYPE OF MOUNTING**

To a large extent, the available space and the required degree of isolation of live parts determine the mounting construction of a circuit-breaker. Generally speaking, for simple plants of not over 3000-kilovolt ampere capacity requiring panels up to 800-ampere capacity and where the voltage is not higher than 2500, single-frame circuit-breakers can be mounted directly on a switchboard panel, on the panel frame, or on a separate pipe-mounting bracket. Where the requirements exceed these, remote control with the circuit-breaker mounted away from the board and controlled from the panel either by direct mechanical connection or by an auxiliary electrical circuit becomes advisable. Where a high degree of isolation is not necessary, open mounting of breakers on wall or pipe frames is permissible. For large power houses and high-capacity substations of moderate voltages, where it is necessary

to isolate the units as much as possible, the cell-mounting circuit-breaker is desirable. See Figs. 110 to 114 for suggested arrangements.

**Summary of Types of Mounting Available**

**Manually Operated**

Type of Breaker	MOUNTING					
	Panel	Panel Frame	Wall	Pipe Frame	Pole	Subway
I	Yes	No	Yes	No	No	No
D	Yes	No	Yes	No	Yes	Yes
F-10	No	No	Yes	No	No	No
QF	Yes	Yes	Yes	Yes	No	No
F-11, F-22	Yes	No	Yes	Yes	No	No
F-33	No	No	Yes	Yes	No	No
<b>Electrically Operated</b>						
F-22	No	No	Yes	Yes	No	No
F-33	No	No	Yes	Yes	No	No

**HANDLE AND COVERPLATE**

The coverplate with handle for the manually-operated indoor breakers is mounted on the front of the panel or pipe-frame brackets. A similar type of coverplate arrangement is used on the types **D QF** and **F-33** manually-operated breakers.

frame, or wall mounting, presents a neat and uniform appearance on its front due to the use of a similar style and type of coverplates and operating handles.

A new design coverplate is used with the F-11 and F-22 breakers which differ slightly from the others in appearance and in the method of attaching the auxiliaries. A switchboard or other switching scheme carrying a system of manually-operated Westinghouse breakers, either panel mounting, panel-frame mounting, or remote-control pipe-

The full-automatic manually-operated types **QF** and all **F** oil circuit-breakers have the overload trip mechanism (coils, releasing triggers, etc.) mounted in the coverplate.

One or more operating handles may extend through the coverplate depending upon the breaker construction.

**TERMINAL INSULATION**

In order to preclude the possibility of dust and dirt collecting on exposed insulating surfaces, reducing the insulating value of such surface so that flashover between terminals or between terminals and ground may occur on the outside of the breaker, it is recommended that on service voltages of 2200 and over, all exposed terminals be insulated after installation. This also prevents the possibility of short-circuiting terminal leads by conducting gases

expelled from the tanks and vents when the circuit-breaker ruptures heavy short-circuits.

For many Westinghouse oil circuit-breakers special micarta insulating tubes are made for this purpose; these are listed under "Oil Circuit-Breaker Accessories." These tubes, when provided with caps at the top, provide an easily removable and effective form of terminal insulation. However, for ordinary service, taping of exposed leads is all that is required.



OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

OIL

(For more complete information on insulating oils, see Section 5-B on "Westinghouse Insulating Materials, Babbitts and Solders.")

(For oil drying and purifying outfits, for cleaning and dehydrating insulating oils, see Section 4-B on "Westinghouse Transformer Apparatus and Testing Equipment.")

For ordinary use, the standard Wemco B (high-flash) oil used with oil circuit-breakers, and a quantity sufficient for the circuit-breaker is regularly furnished as standard (and is included in the list price.) This oil begins to thicken at a tem-

perature of 15 degrees Fahrenheit. When oil circuit-breakers are installed in locations where they will be subjected to lower temperature than this, Wemco C oil should be used (and ordered as an additional item on the order.) Wemco C oil does not begin to thicken until the temperature of minus 50 degrees Fahrenheit is reached.

Satisfactory operation of oil circuit-breakers depends upon the use of suitable oil; hence, use only oil furnished with the breaker or recommended therefor by the breaker manufacturer.

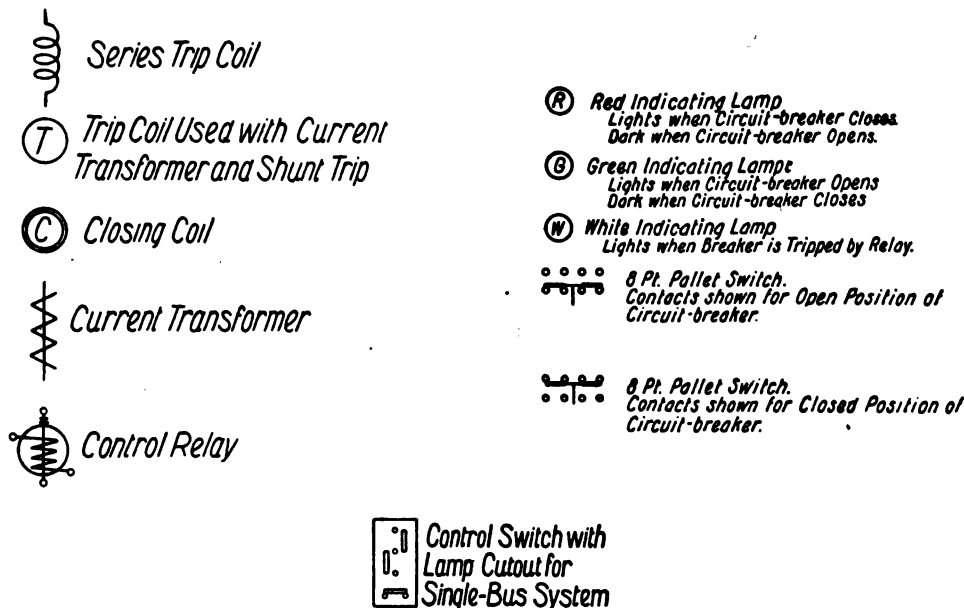
DIAGRAMS OF TYPICAL CIRCUIT-BREAKER CONNECTIONS

Index

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<b>UNDERVOLTAGE TRIP</b>	106 to 109	
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For other diagrams of typical connections refer to Section 3-B, "Westinghouse Instruments and Relays," and to Westinghouse Switchboard Data Book.

Key to Symbols Used



\*Like-polarity primary and secondary terminals of current transformers are marked with white or black tape. All current transformers must be connected with the same polarity (color) of primary terminal nearest the breaker. For diagram purposes as outlined, current-transformer secondary terminals have the same polarity (color) as the primary terminal shown adjacent thereto.

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

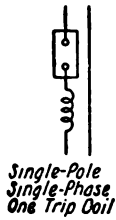


FIG. 1

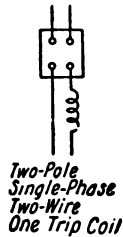


FIG. 2

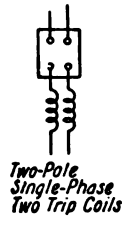


FIG. 3

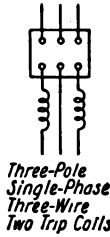


FIG. 4

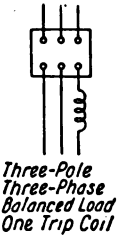


FIG. 5

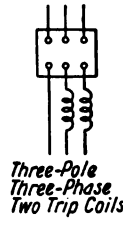


FIG. 6

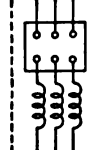


FIG. 7

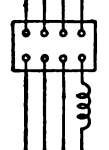


FIG. 8

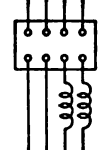


FIG. 9

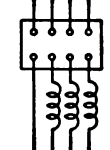


FIG. 10

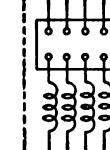


FIG. 11

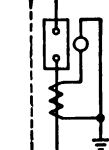


FIG. 12

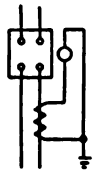


FIG. 13

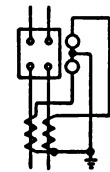


FIG. 14

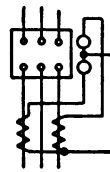


FIG. 15

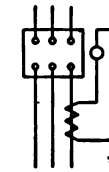


FIG. 16

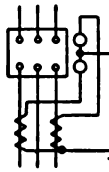


FIG. 17

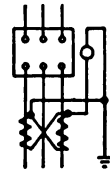


FIG. 18

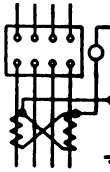


FIG. 19

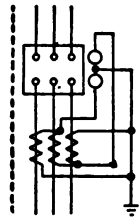


FIG. 20

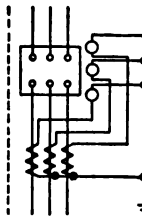


FIG. 21

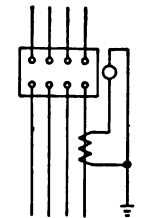


FIG. 22

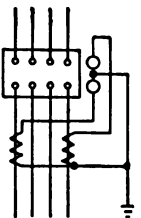


FIG. 23

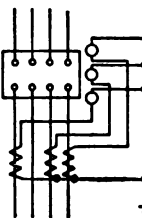


FIG. 24

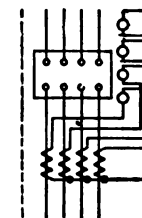


FIG. 25

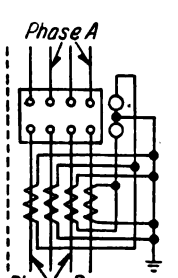


FIG. 26

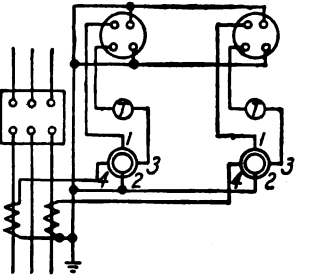


FIG. 27

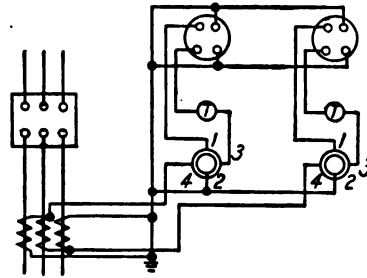
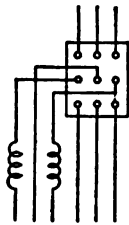


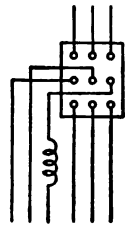
FIG. 28

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued



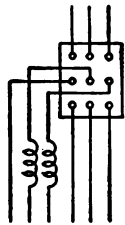
Three-Pole  
Single-Phase  
Three-Wire  
Two Trip Coils

FIG. 29



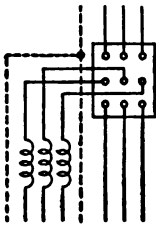
Three-Pole  
Three-Phase  
Balanced Load  
One Trip Coil

FIG. 30



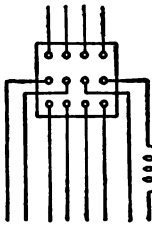
Three-Pole  
Three-Phase  
Two Trip Coils

FIG. 31



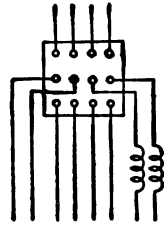
Three-Pole  
Three-Phase  
Three or Four-Wire  
Three Trip Coils

FIG. 32



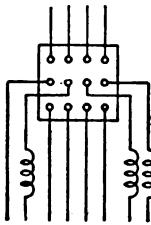
Four-Pole  
Two-Phase  
Balanced Load  
One Trip Coil

FIG. 33



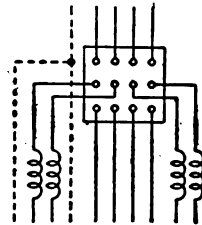
Four-Pole  
Two-Phase  
Two Trip Coils

FIG. 34



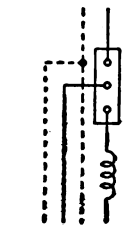
Four-Pole  
Two-Phase  
Four-Wire  
Three Trip Coils

FIG. 35



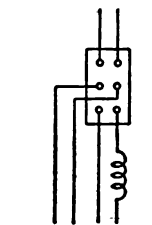
Four-Pole  
Two-Pole  
Four or Five-Wire  
Four Trip Coils

FIG. 36



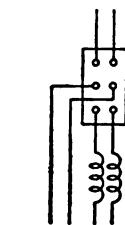
Single-Pole  
Single-Phase  
One Trip Coil

FIG. 37



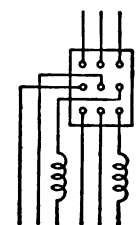
Single-Pole  
Single-Phase  
One Trip Coil

FIG. 38



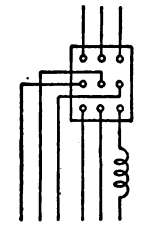
Single-Pole  
Single-Phase  
Two Trip Coils

FIG. 39



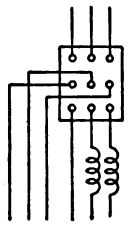
Three-Pole  
Single-Phase  
Three-Wire  
Two Trip Coils

FIG. 40



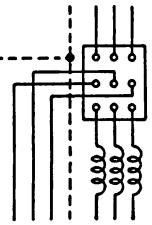
Three-Pole  
Three-Phase  
Balanced Load  
One Trip Coil

FIG. 41



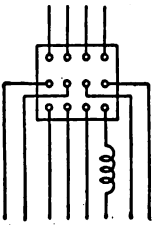
Three-Pole  
Three-Phase  
Two Trip Coils

FIG. 42



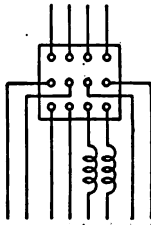
Three-Pole  
Three-Phase  
Three or Four-Wire  
Three Trip Coils

FIG. 43



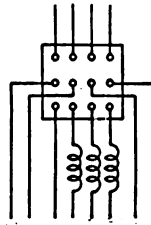
Four-Pole  
Two-Phase  
Balanced Load  
One Trip Coil

FIG. 44



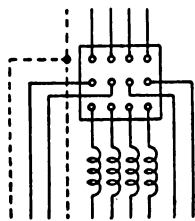
Four-Pole  
Two-Phase  
Two Trip Coils

FIG. 45



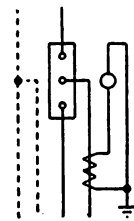
Four-Pole  
Two-Phase  
Four-Wire  
Three Trip Coils

FIG. 46



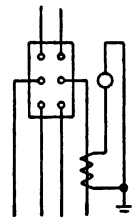
Four-Pole  
Two-Phase  
Four or Five-Wire  
Four Trip Coils

FIG. 47



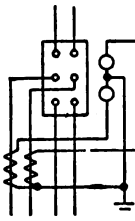
Single-Pole  
Single-Phase  
One Trans  
One Trip Coil

FIG. 48



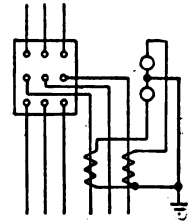
Two-Pole  
Single-Phase  
One Trans  
One Trip Coil

FIG. 49



Two-Pole  
Single-Phase  
Grounded Neutral  
Two Trans  
Two Trip Coils

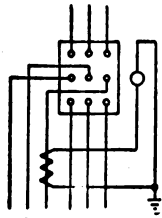
FIG. 50



Three-Pole  
Single-Phase  
Three Wire  
Two Trans  
Two Trip Coils

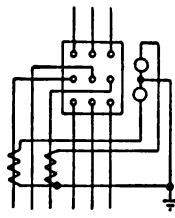
FIG. 51

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued



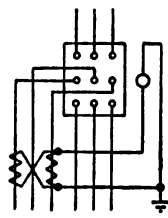
Three-Pole  
Three-Phase  
Balanced Load  
One Transformer  
One Trip Coil

FIG. 52



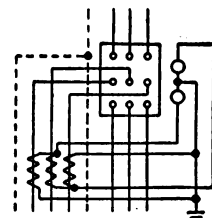
Three-Pole  
Three-Phase  
Balanced Load  
Two Transformers  
Two Trip Coils

FIG. 53



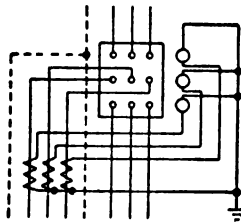
Three-Pole  
Three-Phase  
Balanced Load  
Two Transformers  
One Trip Coils

FIG. 54



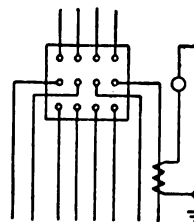
Three-Pole  
Three-Phase  
Three or Four-Wire  
Z-Connected  
Three Transformers  
Two Trip Coils

FIG. 55



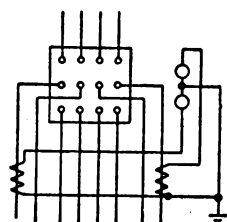
Three-Pole  
Three-Phase  
Three or Four-Wire  
Y-Y Connected  
Three Transformers  
Three Trip Coils

FIG. 56



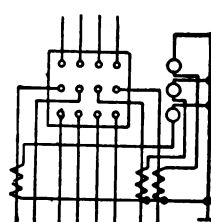
Four-Pole  
Two-Phase  
Balanced Load  
One Transformer  
One Trip Coil

FIG. 57



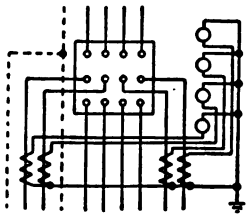
Four-Pole  
Two-Phase  
Balanced Load  
Two Transformers  
Two Trip Coils

FIG. 58



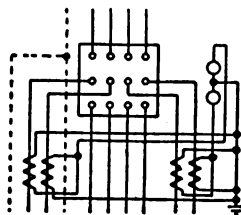
Four-Pole  
Two-Phase  
Inter-connected  
Three Transformers  
Three Trip Coils

FIG. 59



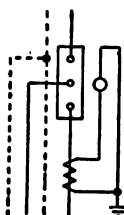
Four-Pole  
Two-Phase  
Four or Five-Wire  
Four Trans  
Four Trip Coils

FIG. 60



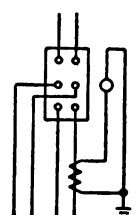
Four-Pole  
Two-Phase  
Four or Five-Wire  
Four Trans  
Four Trip Coils

FIG. 61



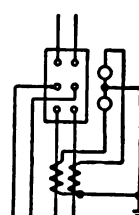
Single-Pole  
Single-Phase  
Two-Wire  
One Trans  
One Trip Coil

FIG. 62



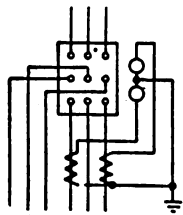
Two-Pole  
Single-Phase  
Two-Wire  
One Trans  
One Trip Coil

FIG. 63



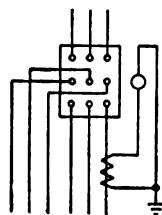
Two-Pole  
Single-Phase  
Two Trans  
Two Trip Coils

FIG. 64



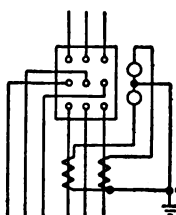
Three-Pole  
Single-Phase  
Three-Wire  
Two Trans  
Two Trip Coils

FIG. 65



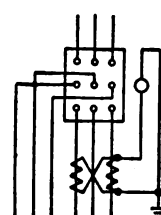
Three-Pole  
Three-Phase  
Balanced Load  
One Trans  
One Trip Coil

FIG. 66



Three-Pole  
Three-Phase  
Balanced Load  
Two Trans  
Two Trip Coils

FIG. 67



Three-Pole  
Three-Phase  
Balanced Load  
Two Trans  
One Trip Coil  
Vector Parallel

FIG. 68

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

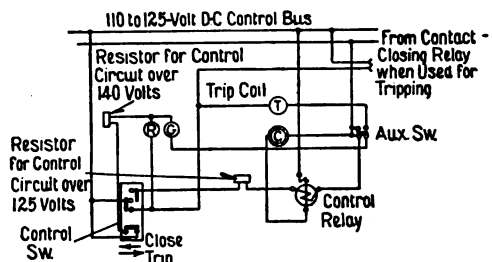
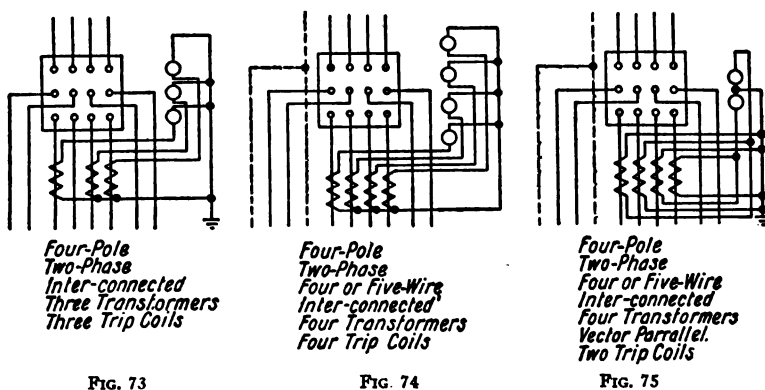
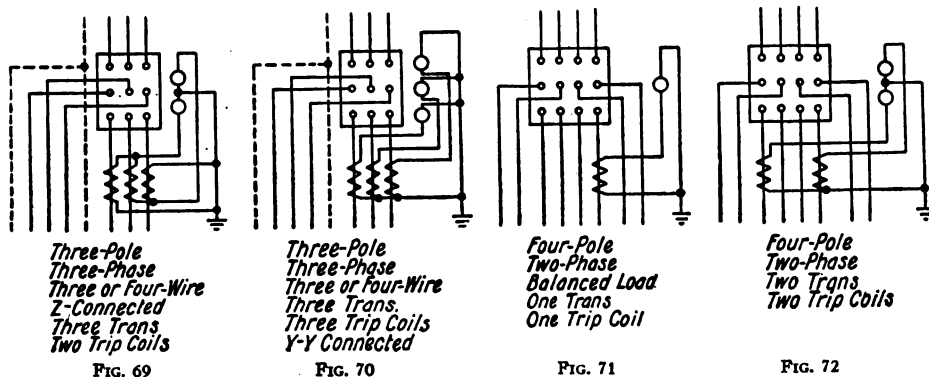


FIG. 76—OPTIONAL METHOD OF LIGHTING LAMPS FOR SINGLE-BUS SYSTEMS WITH LAMP CUTOFF ON CONTROLLER

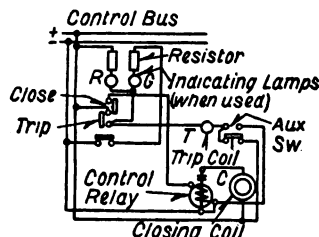


FIG. 77—FOR SINGLE-BUS SYSTEMS, TRIP COIL SUPERVISION AND LAMP CUTOFF ON CONTROLLER

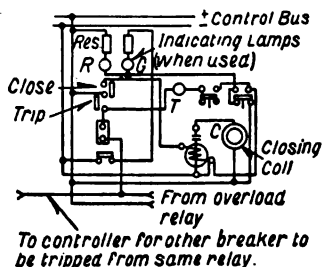


FIG. 78—FOR DOUBLE-BUS SYSTEMS USING BUT ONE SET OF PROTECTIVE RELAYS

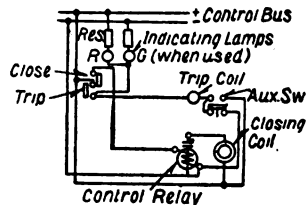
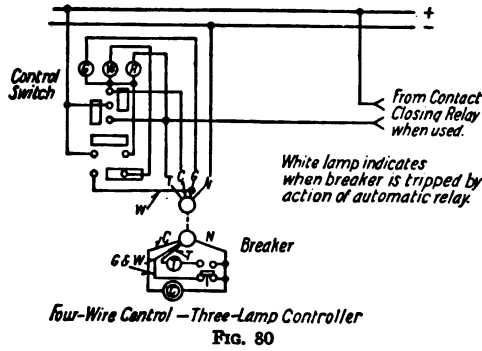
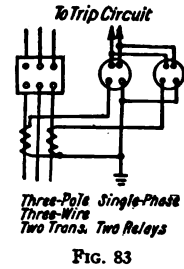
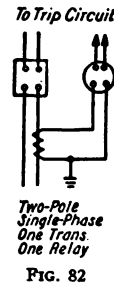
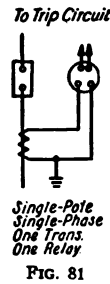


FIG. 79—FOR SINGLE-BUS SYSTEMS, TRIP COIL SUPERVISION

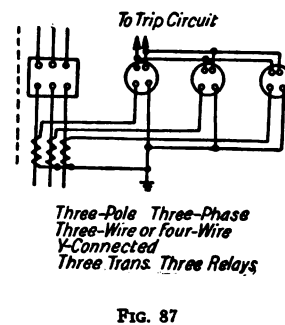
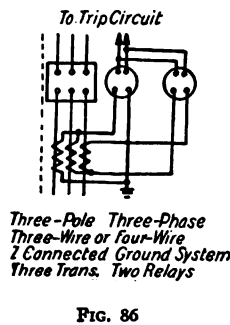
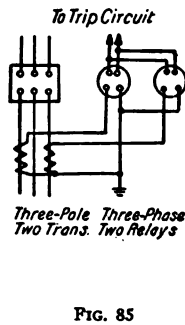
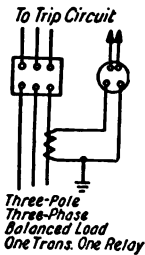
OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued



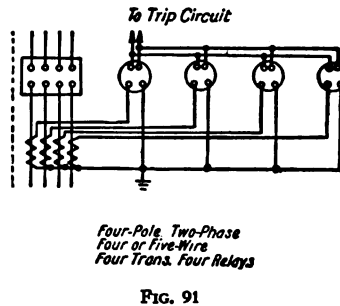
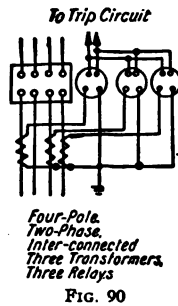
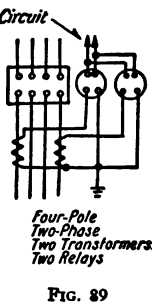
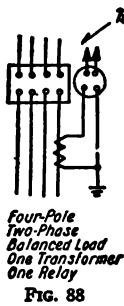
Single-Phase Circuits



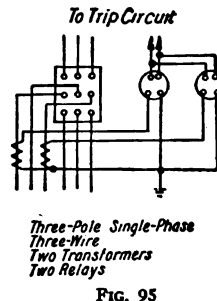
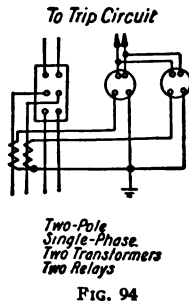
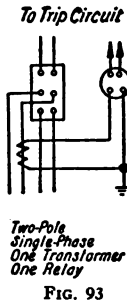
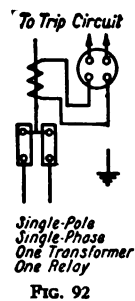
Three-Phase Circuits



Two-Phase Circuits

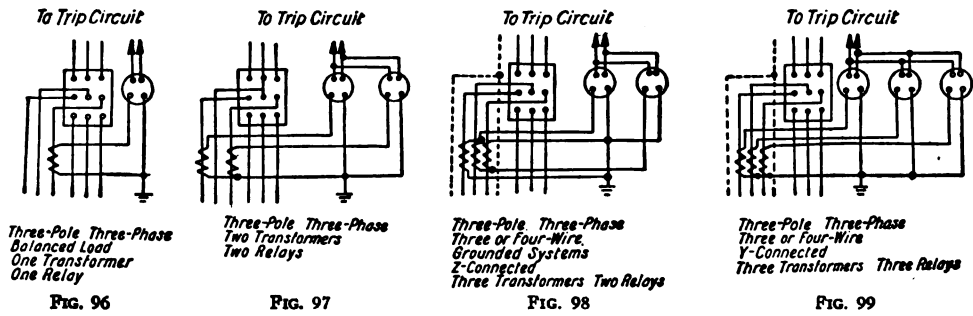


Single-Phase Circuits



OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

Three-Phase Circuits



Two-Phase Circuits

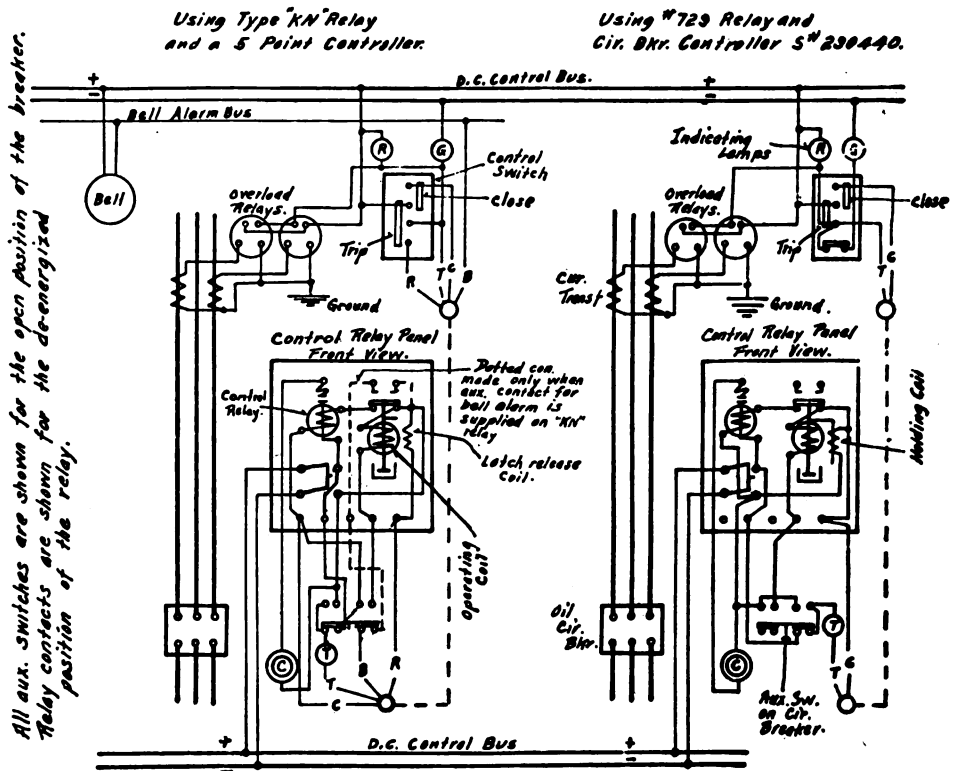
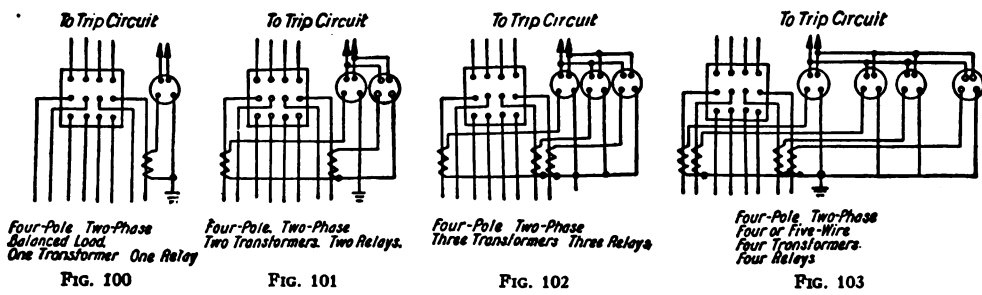
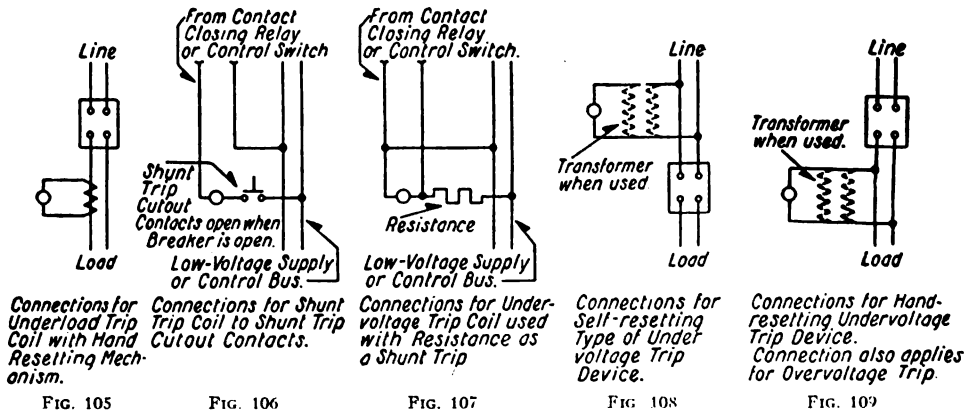
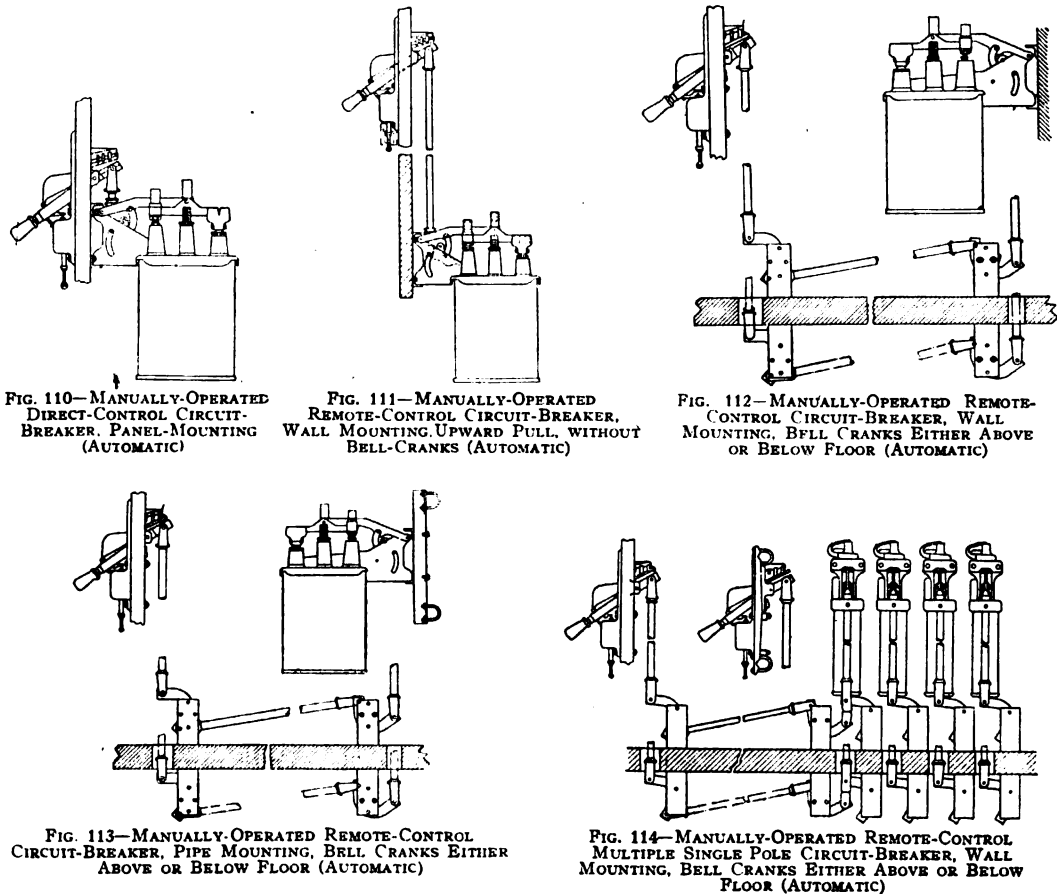


FIG. 104

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued



METHODS OF MOUNTING MANUALLY-OPERATED CIRCUIT-BREAKERS





OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

METHODS OF MOUNTING OF ELECTRICALLY-OPERATED CIRCUIT-BREAKERS

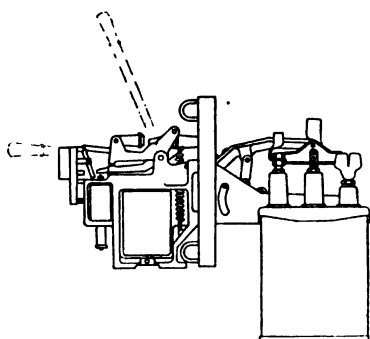


FIG. 115—ELECTRICALLY OPERATED CIRCUIT-BREAKER WALL MOUNTING

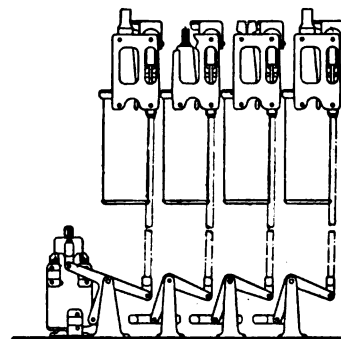


FIG. 116—ELECTRICALLY-OPERATED MULTIPLE SINGLE-POLE CIRCUIT-BREAKER, BELL CRANKS ABOVE FLOOR

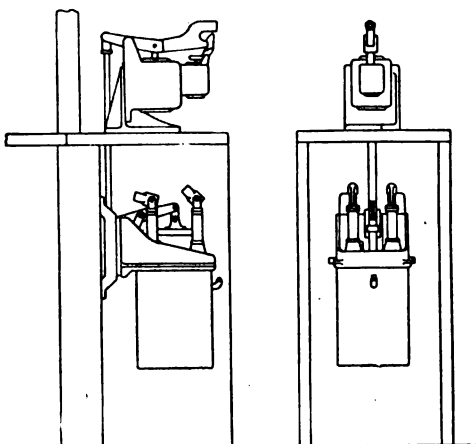


FIG. 117—ELECTRICALLY OPERATED CIRCUIT-BREAKER CELL-MOUNTING MECHANISM ABOVE BREAKER

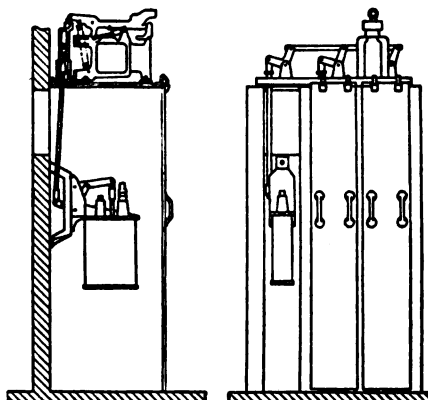


FIG. 118—TYPE F-22 MULTIPLE SINGLE POLE BREAKER ARRANGED FOR CELL MOUNTING WITH MECHANISM ABOVE BREAKER

TYPICAL CIRCUIT-BREAKER AND BUS STRUCTURES

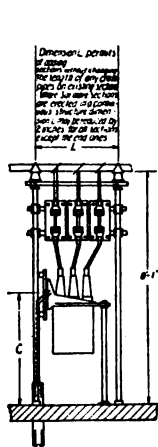


FIG. 119—120

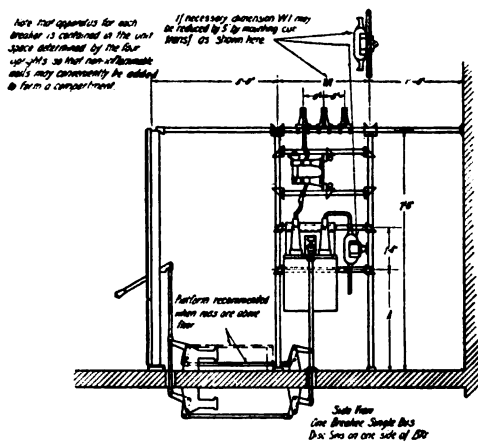


FIG. 119

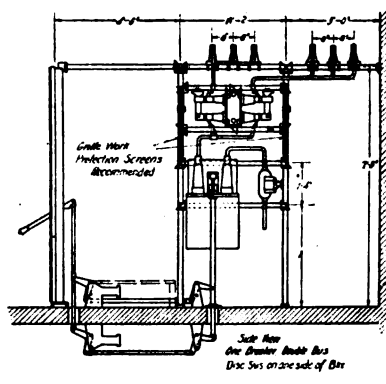


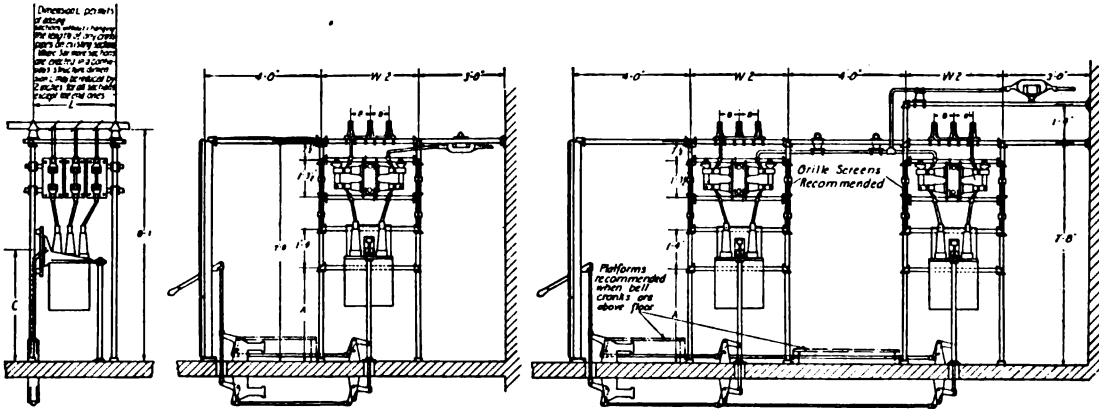
FIG. 120

FIGS. 119 AND 120—OIL CIRCUIT-BREAKER AND BUS STRUCTURE WITH DISCONNECTING SWITCHES ON ONE SIDE OF BREAKER TYPICAL OF STRUCTURES WITH TYPES D, F-11, OR F-22 BREAKERS

Fig. 119 shows a one-breaker single-bus structure.  
Fig. 120 shows a one-breaker double-bus structure.

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

For dimensions see table II.



FIGS. 121-122  
FIG. 121  
FIG. 122  
FIGS. 121 AND 122—OIL CIRCUIT-BREAKER AND BUS STRUCTURE WITH DISCONNECTING SWITCHES ON EACH SIDE OF THE BREAKERS. TYPICAL OF STRUCTURE WITH TYPES D, F-11, F-22 OR F-33 BREAKERS  
Fig. 121 shows a one-breaker single-bus structure.  
Fig. 122 shows a two-breaker double-bus structure.

For description of item numbers see Table I.  
For dimensions see Table II.

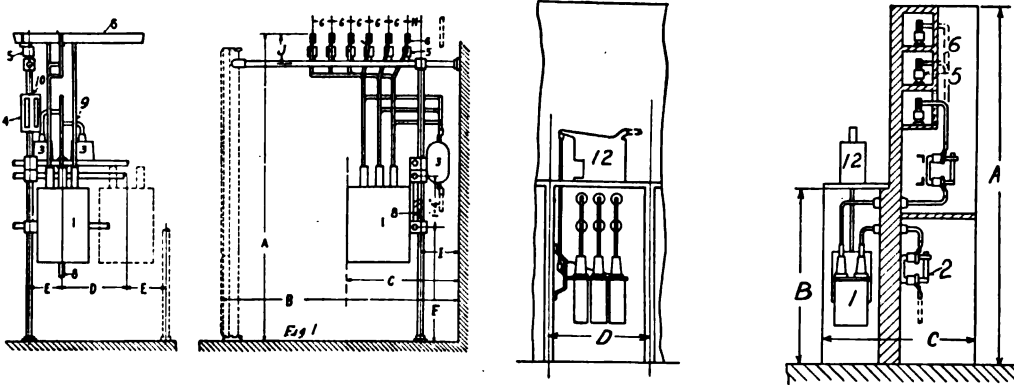
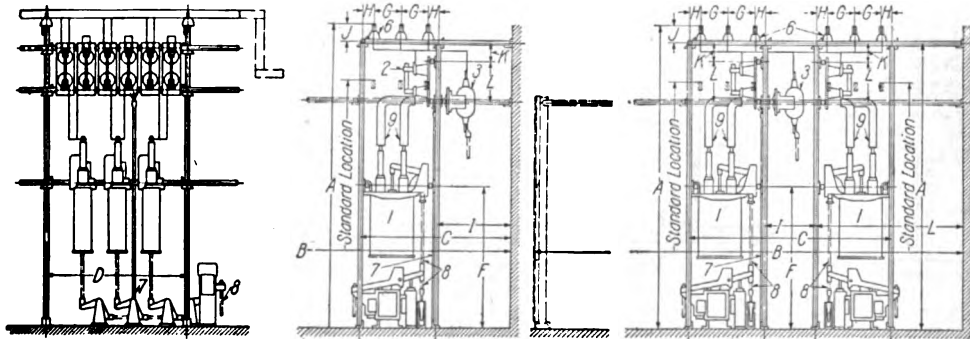


FIG. 123  
FIG. 124  
FIG. 123—OIL CIRCUIT-BREAKER AND BUS-BAR STRUCTURE WITHOUT DISCONNECTING SWITCHES. ONE-BREAKER DOUBLE-BUS SYSTEM. TYPICAL STRUCTURE WITH 300-AMPERE DOUBLE-THROW TYPES D OR F-11 OIL CIRCUIT-BREAKERS  
FIG. 124—OIL CIRCUIT-BREAKER AND BUS-BAR STRUCTURE ENCLOSED CONSTRUCTION, WALL MOUNTING  
Showing typical structure for type F breakers

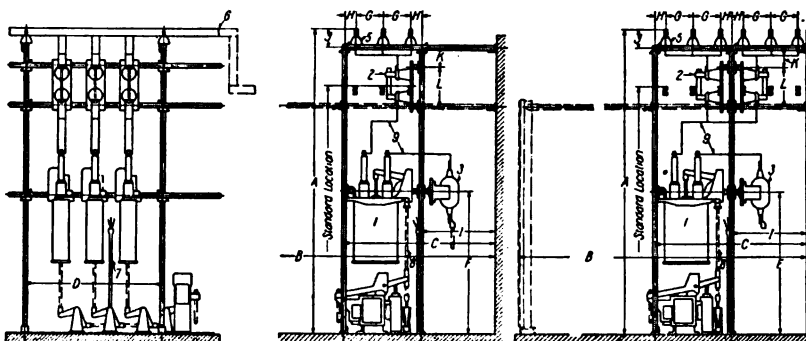
For description of item numbers see Table I.  
For dimensions see Table II.



FIGS. 125 AND 126—OIL CIRCUIT-BREAKER AND BUS STRUCTURE WITH DISCONNECTING SWITCHES ON EACH SIDE OF BREAKER TYPICAL STRUCTURE WITH TYPE F-33 MULTIPLE SINGLE-POLE BREAKERS  
Fig. 125 shows a one-breaker single-bus structure.  
Fig. 126 shows a two-breaker double-bus structure.

OIL CIRCUIT-BREAKERS—GENERAL INFORMATION—Continued

For description of item numbers see Table I.  
For dimensions see Table II.



FIGS. 127 AND 128

FIG. 127

FIG. 128

FIGS. 127 AND 128—OIL CIRCUIT-BREAKER AND BUS STRUCTURE WITH DISCONNECTING SWITCHES ON ONE SIDE OF BREAKER  
TYPICAL STRUCTURE WITH TYPE F-22 MULTIPLE SINGLE-POLE BREAKERS

Fig. 127 shows one-breaker single-bus structure.  
Fig. 128 shows a one-breaker double-bus structure.

Table I—Description of Item Numbers for Figs. 123, 124, 125, 126, 127 and 128

Item No.	Description	Item No.	Description
1	Remote-control manually or electrically operated oil circuit-breaker.	7	Conduit for secondary leads of instrument transformers (supplied by purchaser).
2	Disconnecting switch.	8	Operating rods of circuit-breaker (supplied by purchaser).
3	Current transformer.	9	Voltage transformer. 6600 volts and over.
4	Voltage transformer with primary fuse block and fuses for 2400 volts and under.	10	Voltage transformer primary fuse blocks and fuses for 6600 volts and over.
5	Bus-bar support.	11	Countershaft with operating levers for manually-operated or solenoid-operated breakers.
6	Bus-bars.	12	Solenoid for electrically-operated breakers.

Table II—Circuit-Breaker and Bus Structure Table of Dimensions

All dimensions are approximate and are for reference only in determining the space required for the switchboard equipment. Approved outlines should be obtained from the Company for construction purposes.

APPROXIMATE DIMENSIONS IN INCHES

Fig.	Type of Breaker	A	C	L	W1	W2—CAPACITY OF DISCONNECTING SWITCHES	
						400-A	600-A
119-120	D	25 1/4	32 1/4	27	24	32	35
119-120	F-11	25 1/4	32 1/2	27	24	32	35
119-120	F-22	25 1/4	32 1/2	27	27	32	35
121-122	D	25	32 1/2	27		32	35
121-122	F-11	25	32 1/2	27		32	35
121-122	F-22	36	42 1/2	27		32	35
121-122	F-33	36	42 1/2	28		32	35

DIMENSIONS IN INCHES

Fig.	Type of Breaker	Bus System	A	B		C	D
				*Minimum	Standard		
123	D	Double	96	80	84	32	20
123	F-11	Double	96	84	84	36	28
124	D, F-11, F-22	Single	138	...	...	54	36
125	F-33 (S. P. units)	Single	96	82	84	36	54
126	F-33 (S. P. units)	Double	96	140	144	56	54
127	F-33 (S. P. units)	Single	96	82	84	36	32
128	F-33 (S. P. units)	Double	96	132	132	82	32

\*Figured on the basis of the switchboard proper occupying a space of one foot and of having three-foot aisles. Use standard distance if possible as this dimension must be the same for all breakers in one structure.

## INSTRUCTIONS FOR ORDERING OIL CIRCUIT-BREAKERS

### LIST PRICE INCLUDES

**For Manually-Operated Non-Automatic Breakers**—Breaker with oil.

Standard tube terminals up to 800-ampere 60-cycle capacities, inclusive.

Bell cranks, with remote-control breakers, and panel-mounting face plate.

**For Manually-Operated Automatic Breakers**—In addition to apparatus included with non-automatic breakers, as above, the following:—

Transformer-trip or series-trip coils as ordered.

**For Electrically-Operated Non-Automatic Breakers**—Breaker with oil.

Standard tube terminals up to 800-ampere 60-cycle capacities, inclusive.

Electro-magnet mechanism with shunt closing and tripping coils; with accelerating spring device where necessary; and with the necessary connecting details, except rods, where outline dimension information states that rods are not supplied.

**For Electrically-Operated Automatic Breakers**—In addition to apparatus included with electrically-operated non-automatic breakers, the following:—

Transformer-trip coils.

**For Pipe-Frame Mounting Breakers**—A complete set of frame parts as described.

### LIST PRICES DO NOT INCLUDE

Control switches. Signal lamps.

Relays. Control relays.

Current transformers.

Potential (voltage) transformer.

Pipe control rods, when required for remote-control breakers.

Terminals for capacities above 800-ampere 60-cycle capacities.

Hand-closing levers on electrically-operated breakers (usually one per station for each kind of breaker is sufficient).

**Control Switches and Control Relays**—The standard drum-type control switches as used with the electrically-operated breakers may or may not handle the full closing current of the breaker closing-magnet coils. There may be required in addition to the drum-control switch, a control relay as referred to on the pages of this section on oil circuit-breaker accessories. For application of drum-control switches and control relays, see data under "General Information" and "Operation" of the various types of breakers.

Control relays are not required in the tripping circuit of the breaker when standard Westinghouse relays are used.

### SPECIFY ON ORDER FOR BREAKER

**For Apparatus Included Under a Style Number Refer to Breaker Tables**

**Style number.** Type. Single or double-throw. **Maximum current (amperes)** which the breaker will be required to interrupt. **Amperes.** Service voltage. **Breaker rated voltage.** Cycles (frequency). **Number of poles.** Method of trip (For manually-operated non-automatic or automatic, and for electrically-operated non-automatic or automatic. **Number of transformer trip coils.** If electrically-operated, **method of operation** (direct current or frequency of alternating-current) and **range of operating voltage.** **Mounting** (indoor or outdoor). **Pull.** **Accessories as designated.** **Terminals or contact nuts** (above 800 amperes when ordered), **give size and number of cables per stud, or number of nuts.** Oil.

Also specify on order in breaker item **frequency of the current-transformer trip coils**, when ordered for operation on alternating current.

Also specify on order in breaker item **voltage of the control circuit** at the breaker for electrically-operated breakers. The control voltages are to be specified

by the range in voltage. For example, give the normal voltage as "..... (125) volts, voltage range ..... to ..... (90 to 140) volts." Operating coils for a control voltage of 90 to 140 volts direct current are included in the list price of the breaker. Operating coils having a voltage range other than that specified will be considered special; prices on request. Standard operating coils for a range of 180 to 280 volts, will be furnished at the same price as the coils now included in the list price of the breaker but on special order.

In addition to specifying the voltage of the direct-current closing and shunt-tripping coils, specify **frequency of the alternating-current shunt-trip coils** (only), when ordered to operate on alternating current.

Items not included in the style number or the list price should be specified as **separate items on the order.**

## TYPE I OIL CIRCUIT-BREAKERS

### MANUALLY-OPERATED—NON-AUTOMATIC FOR INDOOR SERVICE—SINGLE AND DOUBLE-THROW

**For Capacities up to 60 Amperes 4500 Volts, A-C.  
Interrupting Capacity at Rated Voltage, 300 Amperes**

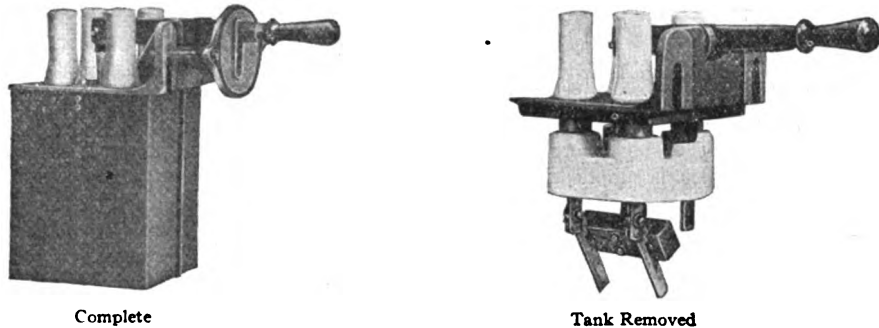


FIG. 1—TWO-POLE, DUST-PROOF, PANEL-MOUNTING BREAKER

#### Application

The type I oil circuit-breakers are two, three or four-pole breakers for controlling inductive loads of small capacity on alternating-current circuits. They are made for either panel or wall mounting and are either dust-proof or dust and damp-proof as listed. The dust and damp-proof wall-mounting forms are particularly adapted as service switches mounted in cellars, kiosks, and outdoor switch-houses, where the breaker is subjected to moisture but not exposed to the weather. The double-throw breakers of this form are often used as service change-over switches on block signal and other systems.

#### Distinctive Features

The characteristic features of the type I oil circuit-breakers are: Knife-blade contacts submerged in oil; live parts carried on porcelain base, affording high quality of permanent insulation between adjacent poles, and between frame and live parts; small space required for mounting; light weight; tanks removable without disturbing contacts, making easy accessibility of parts for the purpose of inspection and repairs, enclosure of all live parts; and low first cost.

#### Operation

The type I oil circuit-breakers are non-automatic manually-operated only. In general, they are opened and closed by one lever-type handle, but the dust and damp-proof switches, Style Nos. 226540 and 226541, have crank-type handles as shown in the illustrations.

Style No. 226540 is a single-throw three-pole breaker having two positions, "on" and "off," as in the regular form.

Style No. 226541 is a double-throw two-pole transfer breaker having three positions, (1) both throws "on," (2) one throw "on" with the other throw "off," and (3) first throw "off" with the second throw "on."

The double-two-pole selector breaker, Style No. 226542, has two lever-type handles, either of which can be in the "on" or "off" position independent of the other, making four combinations; in this breaker both sets of blades are mounted on the same hinge jaws.

The constant-current lighting form of breaker Style No. 119372 has two handles as shown in Fig. 2. One handle operates a single pole used for short circuiting the constant-current regulating device, the other operates two poles for controlling both sides of the line. This form of breaker is available for panel-mounting only.

#### Construction

The panel-mounting form of breaker is designed for mounting on the rear of the switchboard panel

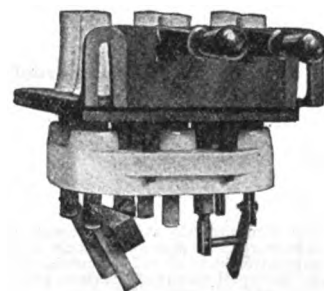


FIG. 2—THREE-POLE, DUST-PROOF, PANEL-MOUNTING, CONSTANT-CURRENT LIGHTING BREAKER—TANK REMOVED

TYPE I OIL CIRCUIT-BREAKERS—Continued

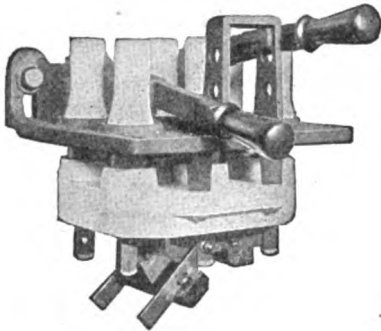


FIG. 3—DOUBLE-TWO-POLE, DUST-PROOF AND DAMP-PROOF, WALL-MOUNTING SELECTOR BREAKER—TANK REMOVED

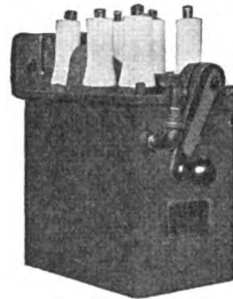


FIG. 4—THREE-POLE, DUST-PROOF AND DAMP-PROOF, WALL-MOUNTING BREAKER

or iron frame bracket. The coverplate through which the handle projects is supplied for mounting on the front of the panel or bracket.

The wall-mounting form of breaker is so constructed that the handle projects over the back of the case, thereby permitting the breaker to be mounted directly on a wall, post, or any convenient vertical support. This feature renders the breaker particularly adaptable for installation in places where no switchboard is available for mounting apparatus.

Tanks—The oil tanks are rectangular in shape and are made of heavy sheet iron. An insulating lining is used as an additional protection against arcing from current carrying parts to the tank metal. The method of fastening the tank to the breaker frame, while secure, permits of easy removal for the purpose of inspection and repair.

Mechanism—The knife-blade contacts are actuated by specially treated wooden rods connected to a lever which is operated by a handle outside of the breaker. This design gives a simple but strong construction.

Terminal Bushings and Studs—The leads are brought out directly at the top. Connections to the outside circuit are made inside the breaker by a socket terminal and a porcelain insulator is slipped over the joint, thus providing a straight continuous connection from the line with maximum insulation.

Contacts—Knife-blade contacts are used as they insure the best contact in this class of breaker for low-temperature rise. The breaker is essentially a knife switch submerged in oil and arranged for external operation.

PRICES

Style number includes the breaker complete as listed with oil (See also "Instructions for Ordering Oil Circuit Breakers").

Poles	Gallons Oil	APPROX. WT., LBS.		Fig. No.	Style No.	List Price
		Net	WITHOUT OIL* Shipping			
<b>Dust-Proof Panel-Mounting†</b>						
<b>Single-Throw</b>						
2	1	10	25	9	119371	\$28 00
3	1½	15	35	9	123242	35 00
3‡	2	17	40	5	119372‡	38 00
4	2½	20	45	9	123243	48 00
<b>Dust-Proof Wall-Mounting</b>						
<b>Single-Throw</b>						
2	1	10	25	9	108099	27 00
3	1½	15	35	9	108100	36 00
4	2½	20	45	9	108101	43 00
<b>Dust-Proof and Damp-Proof Wall-Mounting</b>						
<b>Single-Throw</b>						
3 Selector- Double-Two }	1½	17	40	7	226540	67 00
	2	20	45	8	226542	62 00
<b>Double-Throw</b>						
2	2	20	45	6	226541	62 00

The interrupting capacity at rated voltage of all breakers listed above is 300 amperes. For interrupting capacities at lower than rated voltage refer to pages on "Application of Oil Circuit-Breakers."

\*Approximate weight of oil is 7½ pounds per gallon, net; 9 pounds, shipping.

†Although the type I oil circuit-breakers are insulated for 4500-volt service, engineering practice indicates that panel-mounting breakers should not be used on service voltages higher than 2500 volts. These breakers are made for mounting on panels 2 inches thick. When they are to be mounted on thinner panels, spacers must be used on the mounting bolts.

‡Special switch for use on constant-current lighting panels. For description refer to previous page.

For information as to what material is furnished with these breakers, see "Instructions for Ordering."

TYPE I OIL CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

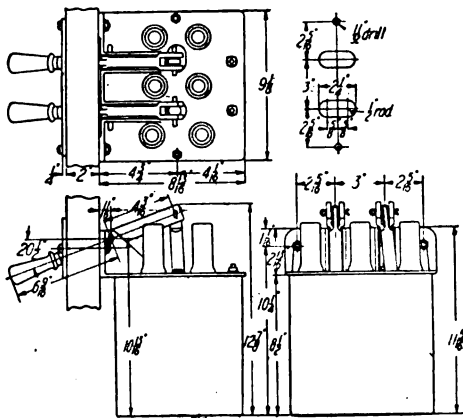


FIG. 5—STYLE No. 119372

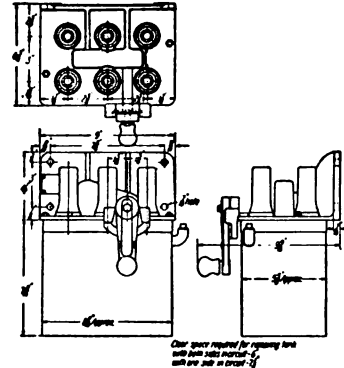


FIG. 6—STYLE No. 226541

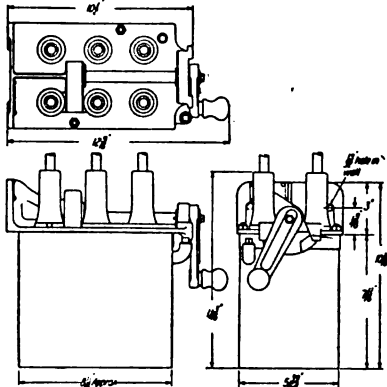


FIG. 7—STYLE No. 226540

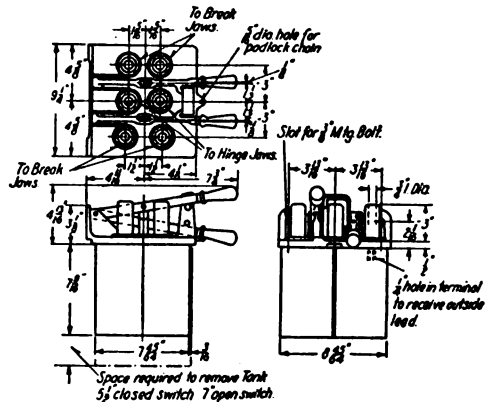


FIG. 8—STYLE No. 226542

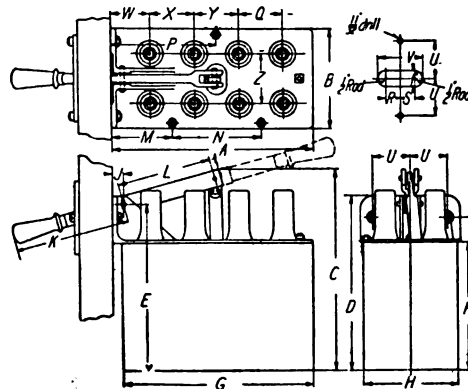


FIG. 9

Style No.	DIMENSIONS IN INCHES																								
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	
119371	6 3/4	6	12	10 1/2	10	7 5/8	6 1/2	5 1/2	11	6 7/8	3 1/2	3 5/8	—	3 5/8	—	7/8	7/8	9	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2	
108099	6 3/4	6	12	10 1/2	10	7 5/8	6 1/2	5 1/2	11	6 7/8	3 1/2	3 5/8	—	3 5/8	—	7/8	7/8	9	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2	
123242	9 3/8	6	12 1/2	10 1/2	10	7 3/4	8 1/4	5 5/8	11	6 7/8	3 1/2	3 5/8	—	6 3/4	—	1	7/8	9 1/2	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2	
108100	9 3/8	6	12 1/2	10 1/2	10	7 3/4	8 1/4	5 5/8	11	6 7/8	3 1/2	3 5/8	—	6 3/4	—	1	7/8	9 1/2	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2	
123243	12	6	12 1/4	10 1/2	10	7 3/4	11 1/8	5 5/8	11	6 7/8	3 1/2	3 5/8	—	5 1/4	6 3/4	2 5/8	1	7/8	9 1/2	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2
108101	12	6	12 1/4	10 1/2	10	7 3/4	11 1/8	5 5/8	11	6 7/8	3 1/2	3 5/8	—	5 1/4	6 3/4	2 5/8	1	7/8	9 1/2	2 1/4	2 3/4	2 1/4	2 5/8	—	3 1/2

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## TYPE D OIL CIRCUIT-BREAKERS

### MANUALLY-OPERATED NON-AUTOMATIC FOR INDOOR, OUTDOOR, AND SUBWAY SERVICE—SINGLE AND DOUBLE-THROW

**For Capacities up to 300 Amperes, 15000 Volts Alternating Current  
Interrupting Capacities at Rated Voltage 700 to 800 Amperes**

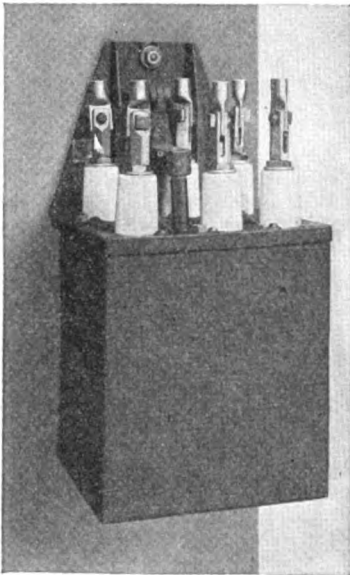


FIG. 1—INDOOR FOR PANEL MOUNTING  
300-AMPERE, 7500-VOLT, TWO-POLE,  
DOUBLE-THROW

#### Application

These non-automatic oil circuit-breakers have a wide range of application, being made for indoor service in panel-mounting, direct wall-mounting, and remote-control wall or pipe-mounting forms; for outdoor service in pole or wall-mounting; and for subway-mounting.

**Indoor Mounting**—The panel-mounting form, as its name indicates, is designed for mounting on the rear of the switchboard panel or frame bracket.

The direct wall-mounting form is particularly adaptable to motor installations, because of the ease with which it may be mounted on any vertical support convenient to the motor operator.

The remote-control wall or pipe-mounting form allows the breaker to be mounted at any suitable place, and operated from a switchboard or other position as desired.

**Outdoor Mounting**—The outdoor form of wall or pole-mounting breaker is primarily intended for service in exposed places. It is particularly adapted for controlling lines where they enter buildings, for controlling branch feeders from the main lines,

for sectionalizing feeders, and cutting out transformers, or for any of the other numerous purposes for which an outdoor form of breaker may be utilized on distribution systems.

**Subway Mounting**—The subway form of breaker is intended for mounting in subways, manholes, or other places where a breaker may be required to operate submerged. The subway form of breaker is made in two, three or four-pole; single and double-throw, for capacities up to 200 amperes, 4500 volts.

**Interrupting Capacity**—The interrupting capacity at rated voltage of the type D 200-ampere breakers is 800 amperes; of the 300-ampere breakers, 700 amperes.

For interrupting capacities of the type D oil circuit-breakers at other than rated voltages, see Tables C and D on pages on "Application of Oil Circuit-Breakers."

#### Distinctive Features

The characteristic features of the type D oil circuit-breakers are:—Knife-blade contacts submerged in oil and protected by auxiliary arcing contacts; live parts carried on insulating supports affording a high quality of permanent insulation between adjacent poles, and between the frame and live parts; all parts supported by a single frame easily mounted on panel, wall, pipe-frame, post bracket, or other vertical support; small space required for mounting; accessibility of parts for the purpose of inspection and repair; enclosure of all live metal parts; simple but strong construction.



FIG. 2—OUTDOOR FOR WALL OR POLE MOUNTING  
200-AMPERE, 4500-VOLT, THREE-POLE,  
DOUBLE-THROW



## TYPE D OIL CIRCUIT-BREAKERS—Continued

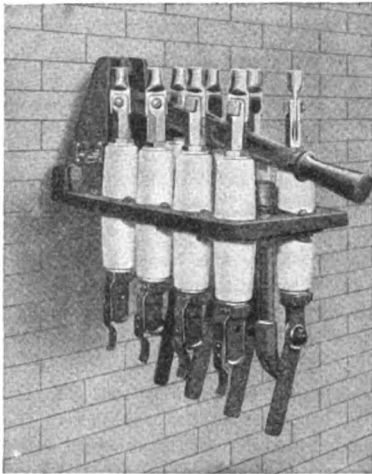


FIG. 3—INDOOR FORM WALL-MOUNTING, 300-AMPERE, 7500-VOLT, FOUR-POLE, SINGLE-THROW (Tank Removed)

### Operation

See Also Pages of this Section on "Oil Circuit-Breakers—General Information"

The type D oil circuit-breakers are non-automatic direct or remote-control, manually operated only. In general, they are opened and closed by one lever-type or crank-type handle, except in the case of a double two-pole breaker. In the double two-pole breaker there is a separate handle for each part of the breaker.

### Construction

#### Indoor Form

**Mounting**—The panel-mounting form of breaker is designed for mounting on the rear of the switchboard panel, or iron frame bracket; the coverplate through which the handle projects, is supplied for mounting on the front of the panel or bracket.

The wall-mounting form of breaker is so constructed that the handle projects outward over the tank, thereby permitting the breaker to be mounted directly on a wall, post, or any convenient vertical support. This feature renders the breaker particularly adaptable for installation in places where no switchboard is available for mounting apparatus, and for motor installations where it is desirable to mount the breaker convenient for the motor operator.

The remote-control wall or pipe-mounting form of breaker is so constructed that the breaker proper is mounted directly on a wall, or other vertical support, or upon pipe framework. The breaker mechanism is operated through bell cranks, from a coverplate and handle, mounted on the front of a switchboard panel, iron frame bracket, or other support.

**Tanks**—The oil tanks are rectangular in shape and are made of heavy sheet iron. Individual insulating cells on single-throw breakers, and an insulating lining on double-throw breakers, are used as an additional protection against arcing from current-carrying parts to the metal of the tank.

Where the individual insulating cells are used on the single-throw breakers, they form a separate compartment for each pole. While the tank is securely fastened to the breaker-frame, the construction permits of easy removal for the purpose of inspection and repair.

The tanks are deep to allow ample space above the oil level to act as an expansion chamber for the arc gases, and to reduce slopping of the oil from internal disturbances. The gases are vented through the clearance between the wooden operating rod and the frame.

The multi-pole single tank construction is used throughout in the type D line of breakers.

**Mechanism**—The hinged knife-blade contacts are actuated by specially treated wooden rods connected to a lever, which is operated by a handle outside of the breakers. This design gives a simple but strong construction.

**Terminal Bushings and Studs**—The leads in the 200-ampere, 4500-volt breaker are brought out directly at the top. Connections to the outside circuit are made inside the breaker by a socket terminal, and a porcelain insulator is slipped over the joint, thus providing a straight continuous connection from the line with maximum insulation.

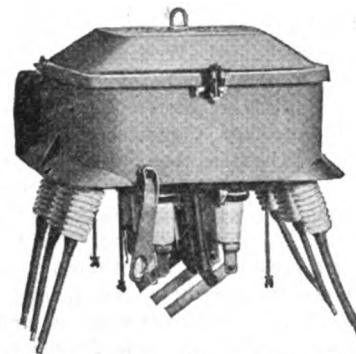


FIG. 4—OUTDOOR-FORM WALL OR POLE MOUNTING, 300 AMPERES—7500 VOLTS WITH TANK REMOVED TO SHOW CONTACTS

In the 300-ampere, 7500-volt breaker, the terminal bushing or stud with stationary contact clips on the lower extremity, is supported by a one-piece vertical, pillar-type, porcelain bushing clamped to the framework. The studs and micarta tube details are clamped to these insulators. This construction avoids the use of babbitt and cement, reducing the cost and the time and labor required for mainte-

## TYPE D OIL CIRCUIT-BREAKERS—Continued

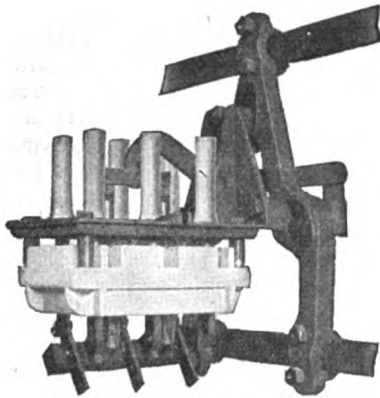


FIG. 5—INDOOR FOR PIPE MOUNTING, REMOTE CONTROL  
200-AMPERE 4500-VOLT, THREE-  
POLE, SINGLE-THROW  
(Porcelain Insulating Tubes Shown on Terminals)

nance. Lock washers are used on the clamped bolts and current-carrying parts, to prevent loosening from vibration or hammer blows that might occur in the operation of the breaker or from other apparatus located nearby.

**Terminals and Terminal Lugs**—On the 300-ampere, 7500-volt breaker, copper tube terminals are supplied. For connecting this form of terminal to the terminal stud, a brass or copper sleeve is supplied, threaded at one end to screw to the stud, and split at the other end to receive the flat end of the tube terminal. The copper tube terminal is held in the slot of the sleeve by a bolt, supplied with a lock washer. On special order, terminals may be omitted, or contact nuts with or without special terminals supplied. Westinghouse—Frankel Solderless Connectors can be supplied on these breakers. For prices see pages on these connectors.

**Main and Auxiliary Contacts**—Hinged knife-blade contacts are used, as they insure the best contact in this class of breaker for low-temperature rise. The main contact jaws are flared so that the knife-blade readily engages upon closing. The breaker is essentially a knife switch submerged in oil and arranged for external operation. The main moving contacts are extended so as to engage an auxiliary arcing piece, mounted on or attached to the stationary main contact jaw. This auxiliary contact takes the final break, thus preventing any burning of the main contacts. The arcing pieces are inexpensive and readily replaced when worn or burned away.

#### Special Breakers

The double two-pole breakers are in reality two, two-pole breakers mounted one behind the other in the same case, and each controlled by its own handle. This arrangement gives a very compact breaker for controlling two circuits, when there is not room on the switchboard panel for two separate

breakers. These breakers are two-pole, single and double-throw.

#### Outdoor Form

The wall or pole-mounting breaker is enclosed in a weather-proof case having lugs cast thereon for mounting the breaker on a wall or pole. On breaker, Style No. 257694, stirrups are also provided for mounting the breakers beneath the cross-arm.

In these breakers, the contact and insulation construction is exactly the same as described for the indoor forms, the only difference being in the construction of the handle and the method of bringing out the leads. On these outdoor breakers a crank handle is used for operation. The leads are brought out underneath the top part of the case, through sealed bushings at the side and underneath the main casting. The sealing-in of the bushings prevents the entrance of rain or moisture to the interior of the breaker.

These breakers do not have excessive insulation and should not be installed on lines subject to surges above the insulation test values given in rule 7323 of the April, 1921, edition of the "Standard Rules of the A. I. E. E.," unless protected by lightning arresters or other surge protective devices.

#### Subway Form

The housing for the subway breaker complete, including the oil tank, is of cast iron. All housing joints are made water-proof by the use of gaskets. The housing has lugs cast thereon for mounting the breaker on the wall of the subway, manhole or other place of mounting.

In the subway form of breaker, the contact and insulation construction is the same as that described on a previous page for the indoor form of breaker the only difference being in the method of bringing out the leads. The leads enter the breaker housing through individual water-proof bushings in the top of the case. The operating handle is provided with a water-proof stuffing box and is latched in either the **on** or **off** position.

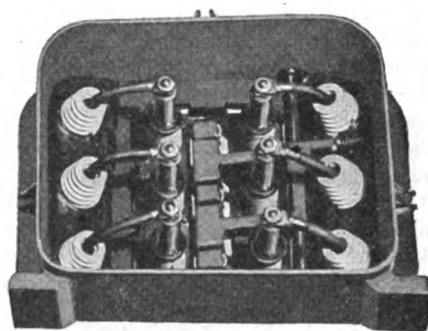


FIG. 6—OUTDOOR-FORM WALL OR POLE MOUNTING 300 AMPERES  
7500 VOLTS, WITH COVER REMOVED TO SHOW TERMINAL  
AND LEAD ARRANGEMENT

TYPE D OIL CIRCUIT-BREAKERS—Continued

PRICES

Except where noted, style number includes the breaker complete as listed, with oil. See also "Instructions for Ordering Oil Circuit-Breakers."

INDOOR FORM—DIRECT-CONTROL

Maximum Continuous Amperes	Maximum Volts	Poles	Dimension Reference Fig.	Gallons Oil	APPROX. WT., LBS.		Style No.	List Price
					Net	WITHOUT OIL* Shipping		
<b>Panel-Mounting†—Single-Throw</b>								
200	4500	2	9	1½	30	50	27738	\$ 70 00
300	7500	2	11	3	70	100	203428	103 00
200	4500	3	9	2	40	65	27741	87 00
300	7500	3	11	3	80	115	203429	128 00
200	4500	4	9	2½	50	78	27748	114 00
300	7500	4	11	4	95	135	203430	167 00
<b>Double-Throw</b>								
200	4500	2	10	2	45	68	27751	92 00
300	7500	2	12	5	90	125	203431	126 00
200	4500	3	10	3	60	88	27758	112 00
300	7500	3	12	5	110	150	203432	161 00
200	4500	4	10	3½	75	108	27761	149 00
300	7500	4	12	6	125	175	203433	200 00
<b>Double Two-Pole</b>								
200	4500	Single-Throw	9†	2½	50	78	58850	160 00
200	4500	Double-Throw	10†	3½	75	108	58851	218 50
<b>Wall-Mounting—Single-Throw</b>								
200	4500	2	9	1½	30	50	27766	70 00
300	7500	2	11	3	70	100	203434	103 00
200	4500	3	9	2	40	60	27771	87 00
300	7500	3	11	3	80	115	203435	128 00
200	4500	4	9	2½	50	78	27776	114 00
300	7500	4	11	4	95	135	203436	167 00
<b>Double-Throw</b>								
200	4500	2	10	2	45	68	27781	92 00
300	7500	2	12	5	90	125	203437	126 00
200	4500	3	10	3	60	88	27786	112 00
300	7500	3	12	5	110	150	203438	161 00
200	4500	4	10	3½	75	108	27791	149 00
300	7500	4	12	6	125	175	203439	200 00

INDOOR FORM REMOTE-CONTROL—Bell Cranks Above or Below Floor

Maximum Continuous Amperes	Maximum Volts	Poles	Dimensions Reference Fig.	Gallons Oil	APPROX. WT., LBS.		STYLE No.		List Price
					Net	WITHOUT OIL* Shipping	Wall-Mounting	Pipe-Mounting	
<b>Single-Throw</b>									
200	4500	2	9, 13	1½	70	110	206000	206036	\$ 95 00
300	7500	2	11, 13	3	110	150	206012	206048	128 00
200	4500	3	9, 13	2	80	115	206001	206037	112 00
300	7500	3	11, 13	3	120	170	206013	206049	163 00
200	4500	4	9, 13	2½	90	125	206002	206038	139 00
300	7500	4	11, 13	4	135	180	206014	206050	182 00
<b>Double-Throw</b>									
200	4500	2	10, 14	2	90	125	206003	206039	112 00
300	7500	2	12, 14	5	135	180	206015	206051	166 00
200	4500	3	10, 14	3	105	145	206004	206040	142 00
300	7500	3	12, 14	5	155	210	206016	206052	181 00
200	4500	4	10, 14	3½	120	170	206005	206041	179 00
300	7500	4	12, 14	6	170	235	206017	206053	230 50

\*Approximate weight of oil equals 7½ pounds per gallon, net; and 9 pounds, shipping.  
 †Same dimensions as the four-pole 200-ampere breaker shown under this reference.

Although the type D oil circuit-breakers are insulated for 4500 or 7500-volt service, engineering practice indicates that panel-mounting breakers should not be used on service voltages higher than 2500 volts. These breakers are made for mounting on material 2 inches thick. When they are to be mounted on thinner panels, spacers must be used on the mounting bolts. Spacers will be furnished free of charge when ordered with the breaker.

The coverplates controlling remote-control manually-operated breakers are designed for mounting on 2-inch material. When these coverplates are to be mounted on material less than 2 inches thick, spacers must be used on the mounting bolts; when they are to be mounted on material between 2 and 4 inches thick, longer mounting bolts than standard are required. Spacers or longer mounting bolts will be furnished free of charge when ordered with the breaker.

For information as to material furnished with these breakers (nuts, cable terminals, etc.), see "Instructions for ordering."

Order by Style Number

TYPE D OIL CIRCUIT-BREAKERS—Continued

OUTDOOR-FORM

Wall or Pole-Mounting

Maximum Continuous Amperes	Maximum Volts	Poles	Dimensions Reference Fig.	Gallons Oil	APPROX. WT., LBS. WITHOUT OIL*		Style No.	List Price
					Net	Shipping		
<b>Single-Throw</b>								
200	4500	2	15	1½	50	78	257694†	\$ 77 00
200	4500	1	16	1	35	55	57930	65 00
200	4500	2	16	1½	50	78	221943	74 00
200	4500	3	16	2½	66	96	221944	93 00
200	4500	4	16	3	85	125	221945	130 00
300	7500	2	18	4¾	130	175	221949	146 00
300	7500	3	18	4¾	130	175	221950	178 00
200	15000	2	19	6¼	150	200	221953	178 00
200	15000	3	19	6¼	150	200	221954	213 50
<b>Double-Throw</b>								
200	4500	2	17	2½	75	108	221946	106 00
200	4500	3	17	3½	100	138	221947	150 00
200	4500	4	17	4½	130	175	221948	200 00
300	4500	3	20	6½	175	220	257742	238 00

For single-pole switches other than listed, double-pole switches can be used with contacts in series (giving double break) or in parallel (giving double-capacity; i. e., 400 amperes).

SUBWAY-FORM

Maximum Continuous Amperes	Maximum Volts	Poles	Dimensions Reference Fig.	Gallons Oil	APPROX. WT., LBS. WITHOUT OIL*		Style No.	List Price
					Net	Shipping		
<b>Single-Throw</b>								
200	4500	2	21	2	80	115	194389	\$111 50
200	4500	3	21	2½	95	130	194391	133 00
200	4500	4	21	3½	110	150	194393	184 00
<b>Double-Throw</b>								
200	4500	2	22	3	95	130	194390	146 00
200	4500	3	22	3½	110	150	194392	181 00
200	4500	4	22	5	125	170	194394	225 50

For single-pole switches other than listed, double-pole switches can be used with contacts in series (giving double break) or in parallel (giving double capacity; i. e., 400 amperes).

NOTE—With each subway-type of breaker should be ordered the necessary cable bushings from the following table. These are not included in style number but are included in the list price of the breaker.

CABLE BUSHINGS

For Use on Subway-Mounting Switches

Diameter Hole Inches	Style No.	List Price	Diameter Hole Inches	Style No.	List Price
5/8	219970	†	1½	47969	†
¾	47808	‡	1½	59932	‡
1	80010	‡			

\*Approximate weight of oil equals 7½ pounds per gallon, net, and 9 pounds, shipping.

†This breaker is similar to Style No. 221943 which has a special cover and stirrup for cross-arm mounting.

‡Included in price of subway breakers listed above.

For information as to material furnished with these breakers (nuts, cable terminals, etc.), see "Instructions for Ordering."

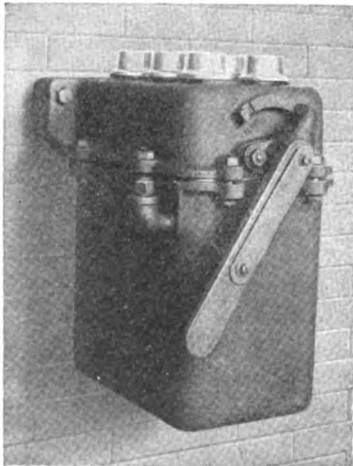


FIG. 7—SUBWAY, 200-AMPERE, 4500-VOLT, THREE-POLE, SINGLE-THROW

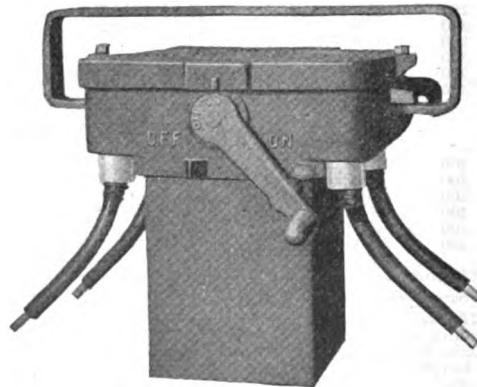


FIG. 8—OUTDOOR-FORM WALL OR POLE MOUNTING 200-AMPERE, 4500-VOLT WITH STIRRUP FOR CROSS-ARM MOUNTING (STYLE NO. 257694 ONLY)

Order by Style Number

TYPE D OIL CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS

Indoor-Form—Panel- and Wall-Mounting

200 Amperes, 4500 Volts

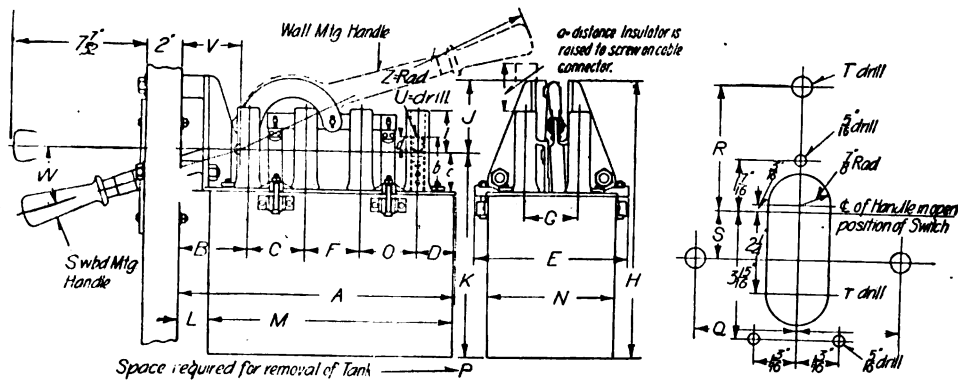


FIG. 9

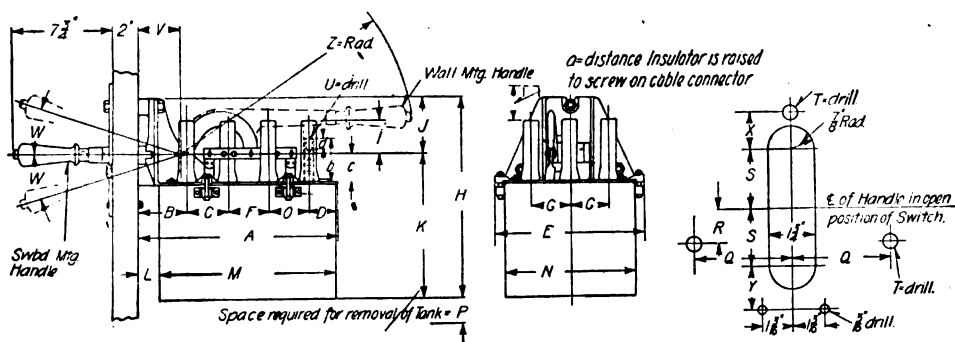


FIG. 10

Poles	DIMENSIONS IN INCHES																										
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P†	Q	R	S	T	U	V	W	X	Y	Z	
<b>Single-Throw—Fig. 9</b>																											
2	8 1/4	3 1/4	3 1/8	2 1/8	8 1/2	...	3	15 1/4	2 3/8	4 1/8	11 1/8	1 1/2	7 1/2	7 1/8	...	8 3/4	2 3/8	3 1/2	1 1/8	1 1/8	2 1/2	1 1/2	21	...	...	13 1/4	
3	12 1/4	3 1/4	3 1/8	2 1/8	8 1/2	3 1/8	3	15 1/4	2 3/8	4 1/8	11 1/8	1 1/2	10 1/2	7 1/8	...	8 3/4	2 3/8	3 1/2	1 1/8	1 1/8	2 1/2	2 3/8	19	...	...	15	
4	15 1/4	3 1/4	3 1/8	2 1/8	8 1/2	3 1/8	3	15 1/4	2 3/8	4 1/8	11 1/8	1 1/2	13 1/2	7 1/8	3 1/8	8 3/4	2 3/8	3 1/2	1 1/8	1 1/8	2 1/2	2 3/8	18	...	...	17 1/2	
<b>Double-Throw—Fig. 10</b>																											
2	8 1/4	3 1/4	3 1/8	2 1/8	11 1/2	...	3	15 3/8	2 3/8	4 1/8	11 1/8	1 1/2	7 1/4	10	...	8 3/4	3 3/8	1 1/8	2 1/4	1 1/8	2 1/2	2 1/2	21	1 1/8	1 1/8	14	
3	12 1/4	3 1/4	3 1/8	2 1/8	11 1/2	3 1/8	3	15 3/8	2 3/8	4 1/8	11 1/8	1 1/2	10 3/4	10	...	8 3/4	3 3/8	1 1/8	2 1/4	1 1/8	2 1/2	2 1/2	19 1/4	1 1/8	1 1/8	15 1/2	
4	15 1/4	3 1/4	3 1/8	2 1/8	11 1/2	3 1/8	3	15 3/8	2 3/8	4 1/8	11 1/8	1 1/2	13 1/2	10	3 1/8	8 3/4	3 3/8	1 1/8	2 1/4	1 1/8	2 1/2	2 1/2	17 1/2	1 1/8	1 1/8	18	

†Space to remove tank.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE D OIL CIRCUIT-BREAKERS—Continued

Indoor Form—Panel- and Wall-Mounting

300 Amperes, 7500 Volts

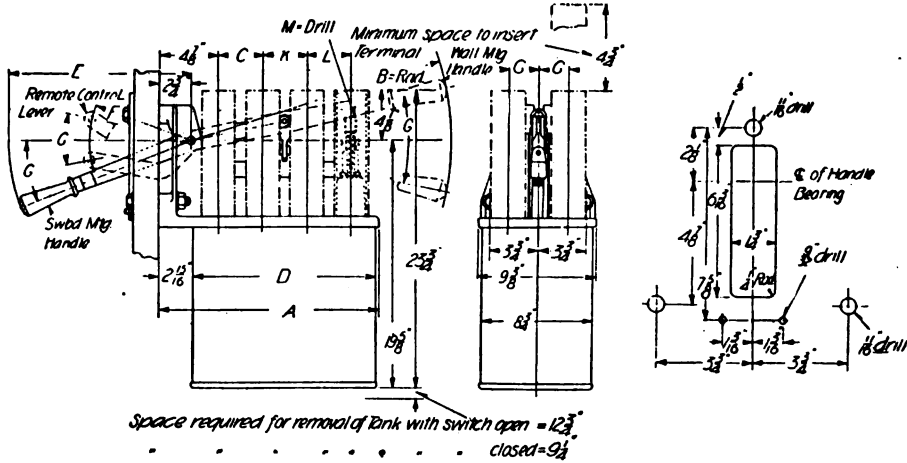


FIG. 11

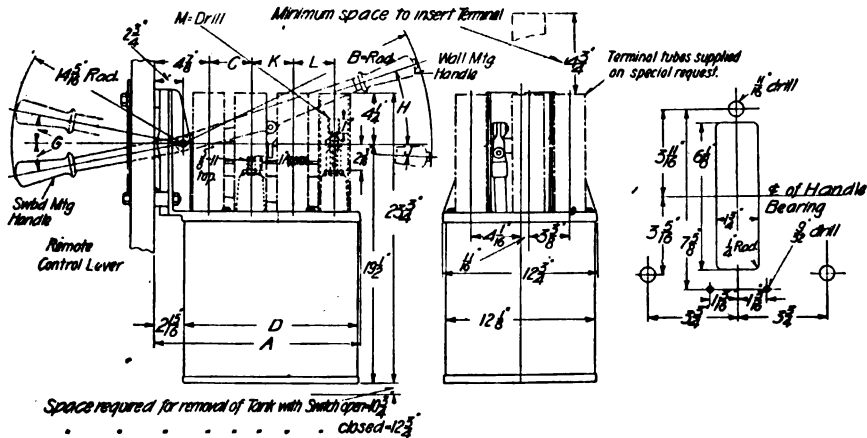


FIG. 12

Single-Throw—Fig. 11

Poles	DIMENSIONS IN INCHES									
	A	B	C	D	E	F	G Degrees	K	L	M
2	14 1/8	17 1/8	7	10 7/8	13 1/4	6	28	...	...	.747
3	14 3/8	17 3/8	3 1/2	10 1/2	13 3/4	6	28	3 1/2	...	.747
4	17 3/8	20 3/8	3 1/2	14 3/8	14	8	22	3 1/2	3 1/2	.747

Double-Throw—Fig. 12

Poles	DIMENSIONS IN INCHES									
	A	B	C	D	G Degrees	H Degrees	J Degrees	K	L	M
2	14 1/8	17 1/8	7	10 7/8	14	25	3	...	...	.747
3	14 3/8	17 3/8	3 1/2	10 1/2	14	25	3	3 1/2	...	.747
4	17 3/8	20 3/8	3 1/2	14 3/8	11	19	3	3 1/2	3 1/2	.747

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE D OIL CIRCUIT-BREAKERS—Continued

Indoor Form—Remote Control For All Indoor Breakers

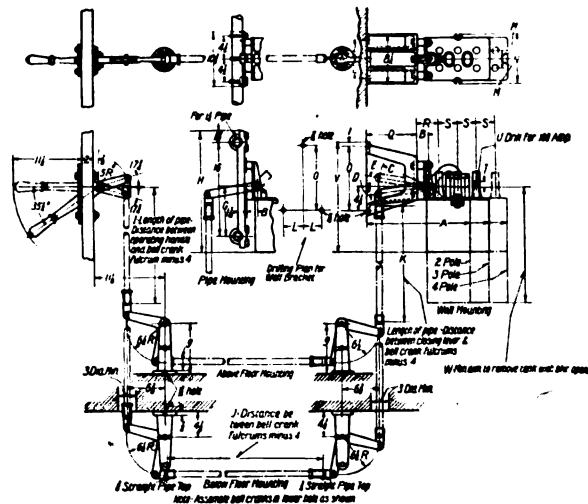


FIG. 13

Single-Throw—Fig. 13

Amps	Volts	Pole	A	B	C	D°	E°	G	H	L	M	N	O	Q	R	S	T	U	V	W
200	4500	2	17 1/2%	3 1/2%	7 1/2%	21	9 1/2%	8 1/2%	20 3/4%	3 1/2%	1 1/2%	8 1/2%	11	8 1/2%	3 1/2%	3 1/2%	1 1/2%	1 1/2%	18%	10 1/4%
200	4500	3	20 3/4%	2	8 3/8%	18	9 1/2%	8 1/2%	20 3/4%	3 1/2%	1 1/2%	8 1/2%	11	8 1/2%	3 1/2%	3 1/2%	1 1/2%	1 1/2%	18%	10 1/4%
200	4500	4	23 3/4%	3 1/2%	8 3/8%	18	9 1/2%	8 1/2%	20 3/4%	3 1/2%	1 1/2%	8 1/2%	11	8 1/2%	3 1/2%	3 1/2%	1 1/2%	1 1/2%	18%	10 1/4%
300	7500	2	22 1/2%	2 3/4%	6	14	11 1/2%	11 3/8%	26 3/8%	3 1/4%	2 3/8%	9 3/8%	14	8	4 3/8%	3 3/8%	2	.747	26%	28 1/2%
300	7500	3	22 1/2%	2 3/4%	6	14	11 1/2%	11 3/8%	26 3/8%	3 1/4%	2 3/8%	9 3/8%	14	8	4 3/8%	3 3/8%	2	.747	26%	28 1/2%
300	7500	4	25 5/8%	2 3/4%	8	11	11 1/2%	11 3/8%	26 3/8%	3 1/4%	2 3/8%	9 3/8%	14	8	4 3/8%	3 3/8%	2	.747	26%	28 1/2%

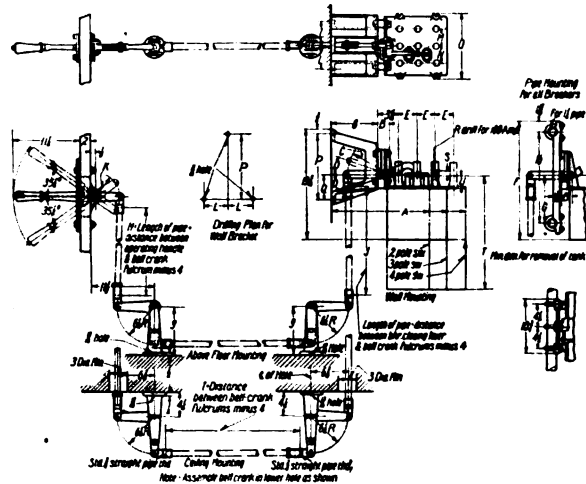


FIG. 14

Double-Throw—Fig. 14

Amps	Volts	Poles	A	B	C	D°	E	F	G	K	L	M	N	O	P	Q	R	S	T	U
200	4500	2	16 1/2%	2 3/8%	6 5/8%	21	3 1/2%	20 3/4%	8 3/8%	4 3/8%	4 1/4%	3	3	11 1/2%	11 1/2%	4 1/4%	1 1/2%	1 1/2%	20	2 1/2%
200	4500	3	20 3/4%	2	6 5/8%	19 1/4%	3 1/2%	20 3/4%	8 3/8%	4 3/8%	4 1/4%	3	3	11 1/2%	11 1/2%	4 1/4%	1 1/2%	1 1/2%	20	2 1/2%
200	4500	4	23 3/4%	3 3/8%	7 1/2%	17 1/2%	3 1/2%	20 3/4%	8 3/8%	4 3/8%	4 1/4%	3	3	11 1/2%	11 1/2%	4 1/4%	1 1/2%	1 1/2%	20	2 1/2%
300	7500	2	22 1/2%	2 3/4%	9 3/8%	14	3 3/8%	27%	9 3/8%	4 3/8%	3 3/8%	3 3/8%	4 3/8%	12 3/4%	14	6%	.747	2	30 1/4%	5 3/4%
300	7500	3	22 1/2%	2 3/4%	9 3/8%	14	3 3/8%	27%	9 3/8%	4 3/8%	3 3/8%	3 3/8%	4 3/8%	12 3/4%	14	6%	.747	2	30 1/4%	5 3/4%
300	7500	4	25 5/8%	2 3/4%	9 3/8%	11	3 3/8%	27%	9 3/8%	4 3/8%	3 3/8%	3 3/8%	4 3/8%	12 3/4%	14	6%	.747	2	30 1/4%	5 3/4%

These dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE D OIL CIRCUIT-BREAKERS—Continued

Outdoor Form—Wall- or Pole-Mounting  
200 Amperes, 4500 Volts

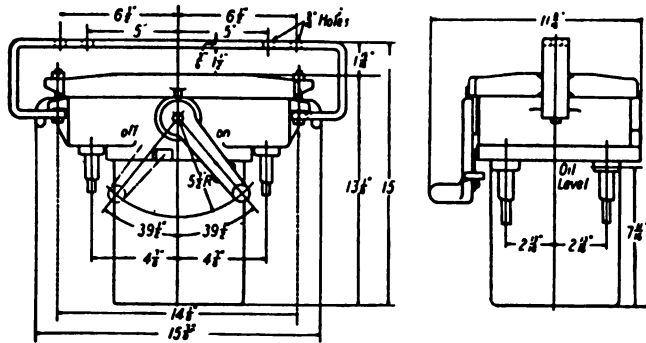


FIG. 15

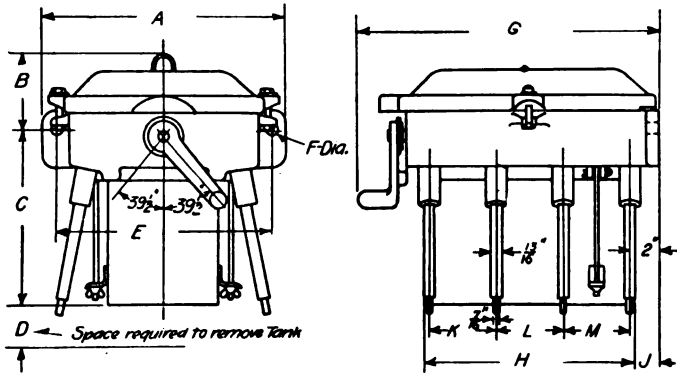


FIG. 16

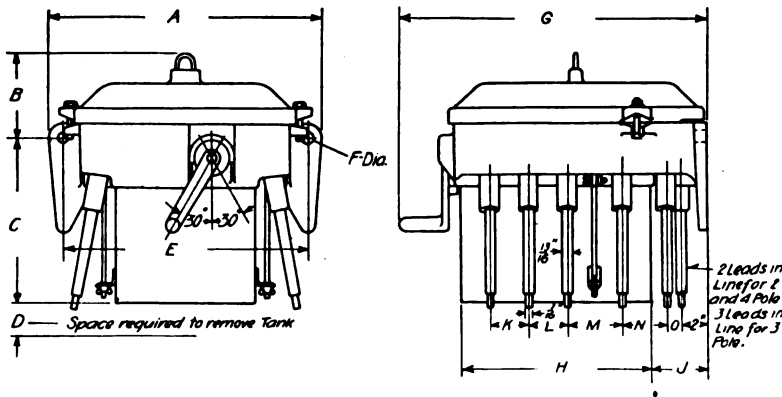


FIG. 17

Poles	DIMENSIONS IN INCHES														
	A	B	C	D	E	F	G	H	J	K	L	M	N	O	
<b>Single-Throw—Fig. 16</b>															
1	16 1/2	3 1/4	11 7/8	...	14 3/4	3/4	9	7 3/4	...	5 1/2	...	...	...	...	
2	15 7/8	5	11 1/8	8	14	1 1/8	12 1/8	7 3/4	1 1/8	5 1/2	...	...	...	...	
3	15 7/8	5	11 1/8	8	14	1 1/8	15 1/8	10 1/2	1 1/8	4 1/2	4 1/8	...	...	...	
4	15 7/8	5	11 1/8	8	14	1 1/8	19 1/8	13 3/8	1 3/4	4 3/8	4 3/8	4 3/8	...	...	
<b>Double-Throw—Fig. 17</b>															
2	19 1/2	5 1/4	11 3/4	9	17 1/2	1 1/4	15 1/4	7 1/4	3 1/4	5 1/4	...	...	2 3/4	...	
3	19 1/2	5 1/4	11 3/4	9	17 1/2	1 1/4	18 1/4	10 3/4	3 1/4	3 3/4	4 1/2	...	2 3/4	...	
4	19 1/2	5 1/4	11 3/4	9	17 1/2	1 1/4	21 1/4	13 3/4	4 1/4	2 3/4	2 3/4	3 3/4	3 3/4	...	

These dimensions are for reference only. For official dimensions apply to the nearest district office.



TYPE D OIL CIRCUIT-BREAKERS—Continued

Outdoor Form—Wall- or Pole-Mounting—Continued

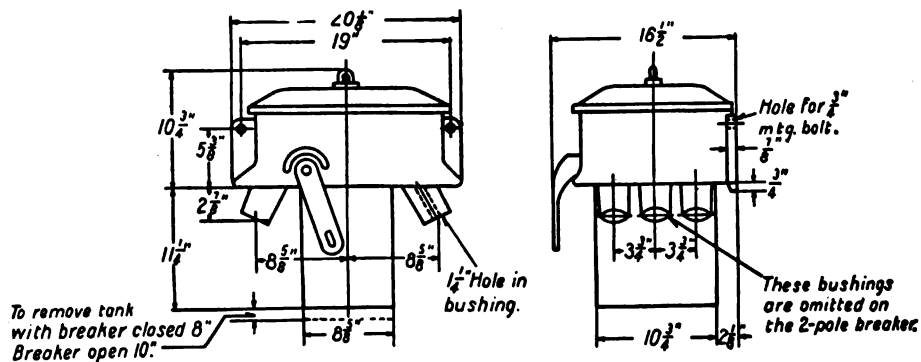


FIG. 18

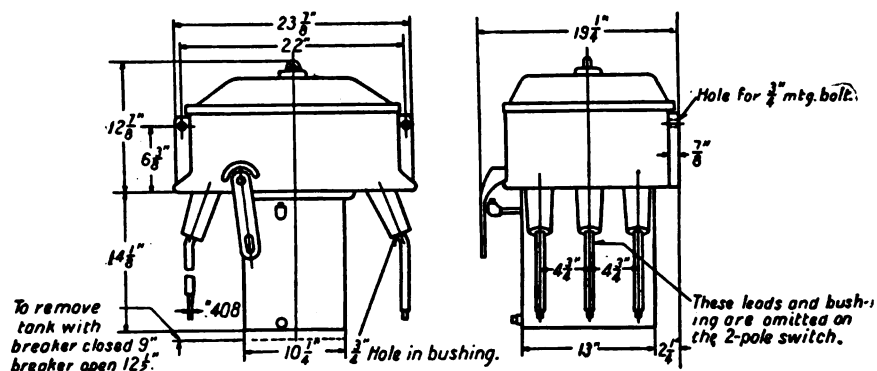


FIG. 19

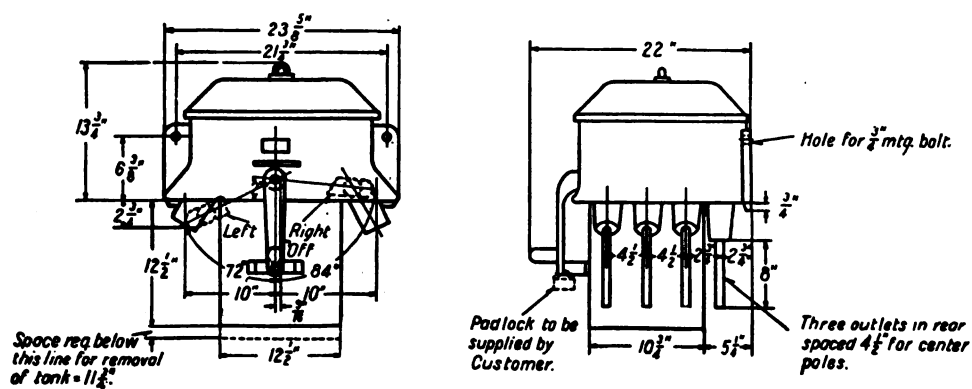


FIG. 20

These dimensions are for reference only. For official dimensions apply to the nearest district office.

TYPE D OIL CIRCUIT-BREAKERS—Continued

Subway Form

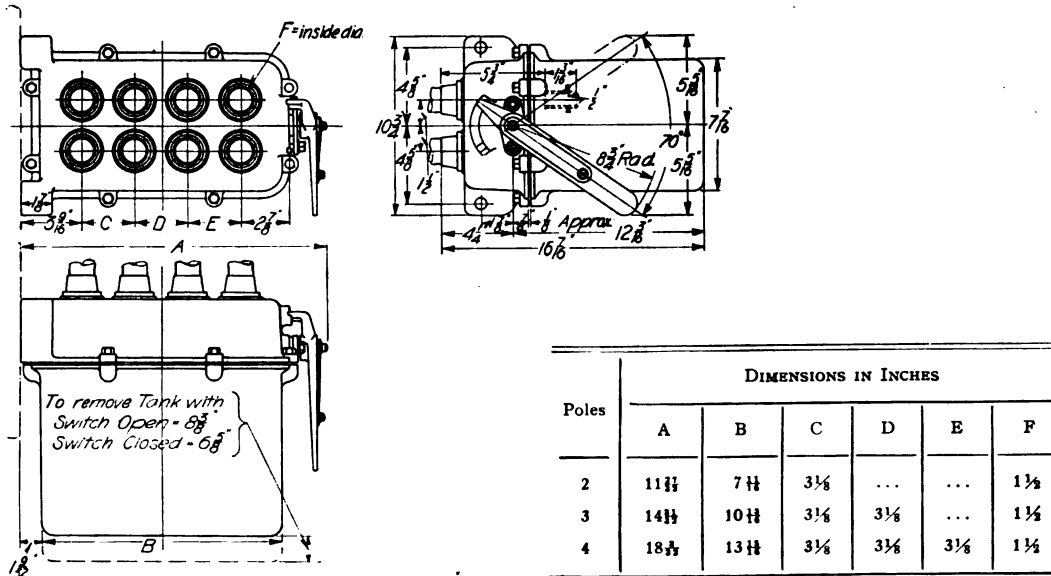


FIG. 21—SINGLE-THROW

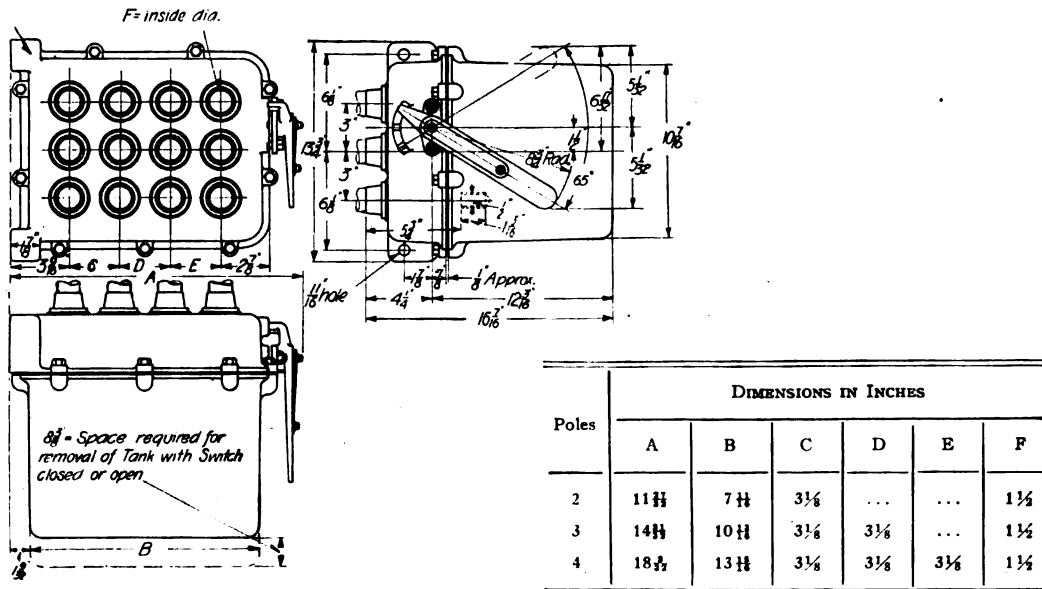


FIG. 22—DOUBLE-THROW

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## TYPE F-10 OIL CIRCUIT-BREAKERS

MANUALLY-OPERATED, NON-AUTOMATIC AND AUTOMATIC  
FOR INDOOR SERVICE, SINGLE AND DOUBLE-THROW

For Capacities up to 200 Amperes, 2500 Volts; 300 Amperes, 750 Volts;  
Alternating Current. Interrupting Capacity  
at 2500 Volts, 3000 Amperes

(Unless otherwise stated ratings are on a 60-cycle basis)

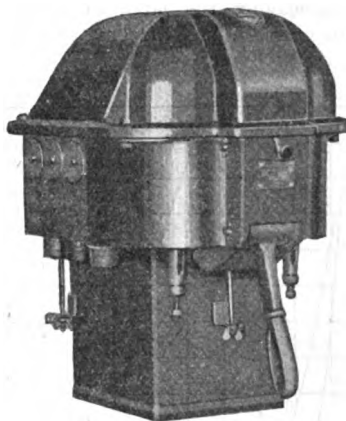


FIG. 1—TYPE F-10 INDOOR, THREE-POLE, SINGLE-THROW 300-AMPERE 750-VOLT OIL CIRCUIT-BREAKER FULL AUTOMATIC WITH OVERLOAD TRIP.

### Application

See also pages on "Application of Oil Circuit-Breakers."

The type F-10 oil circuit-breakers comprise a line of moderate capacity, non-automatic and automatic manually operated breakers for indoor service primarily in industrial applications. This breaker is made in only one form, wall-mounting, for capacities up to 200 amperes at 2500 volts, and 300 amperes at 750 volts.

Because of the excessive moisture and drippings inherent to mines, these drip-proof breakers are being used extensively as low-capacity and low-voltage breakers in such service.

Standard breakers are sufficiently dustproof for use in textile mills and similar service. For more severe applications, such as cement or flour mills where very fine dust is encountered, the standard breakers should be equipped with gaskets. The gaskets are placed between the top cover and the frame and between the oil tank and the frame.

**Slip-Ring Motors**—The starting currents on slip-ring motors usually range from one and a half to two times full-load current, depending upon the characteristics of the motor load, and the number of steps in the starting device. Under these conditions the motor has a power factor nearly as high as when it is running. The breaker selected should, therefore, have a full-load rating equivalent to one and one-half times the full-load motor current, and the calibration of the breaker should provide a maximum setting equal to twice the full-load motor current. With breakers used in starting slip-ring

motors, inverse-time-limit attachments should be used to prevent the breaker from opening when the motor is started, or on momentary overloads. It is also recommended that an undervoltage release attachment be used in this application.

**Squirrel-Cage Motors**—The starting current of squirrel-cage motors usually ranges from 5 to 10 times full-load current at a very low power factor. It is to be noted that the higher starting currents are usually taken by high-speed motors. The breaker selected should have a full-load rating equivalent to one and one-half times full-load motor current and the calibration of the breaker should provide a range of at least two times the full-load current. Due to the high starting currents, the breaker should always be equipped with inverse-time-limit attachments.

When starting heavy-inertia loads, in order that the breaker will not trip on the starting current, it may be necessary to set the tripping point of the breaker too high to properly protect the motor except for short-circuit conditions. If this condition exists, it may be desirable to by-pass the circuit-breaker during starting.

Before selecting the breaker for squirrel-cage motors, the application, and the time required to accelerate the motor should be carefully investigated. Except for smaller motors, it is desirable to install an auto-starter in addition to the breaker. It is recommended that an undervoltage release attachment be used with breakers for this application, if the auto-starter is not so equipped.

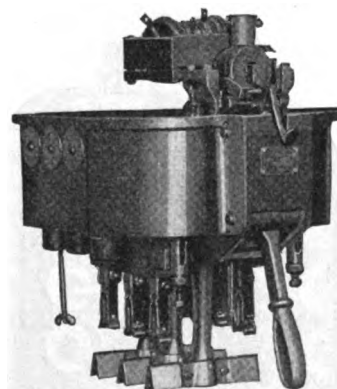


FIG. 2—TYPE F-10 INDOOR, THREE-POLE, SINGLE-THROW, 200-AMPERE, 2500-VOLT OIL CIRCUIT-BREAKER, FULL AUTOMATIC, OVERLOAD TRIP, UNDERVOLTAGE RELEASE WITH TRANSFORMER. TANK AND COVER REMOVED TO SHOW DETAILS OF CONSTRUCTION

TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

Distinctive Features

Among the features which distinguish the type F-10 Breakers are:—

A novel design of contact so shaped that different parts of the same contact surface act as the main current-carrying contact and as the arcing contact, but the arcing contact surface is so located as to prevent arcing on the main current-carrying contact surface.

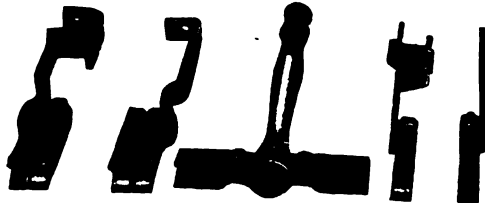


FIG. 3—STATIONARY AND MOVING CONTACT DETAILS FOR TYPE F-10 OIL CIRCUIT-BREAKER. FROM LEFT TO RIGHT: 300-AMPERE STATIONARY CONTACTS; MOVING CONTACT FOR ALL CAPACITIES; 200-AMPERE STATIONARY CONTACTS

Flared wedge contacts under heavy pressure.

Submersion and opening of all contacts under oil.

The ease of changing from non-automatic to automatic breakers by the addition of the various overload devices only.

Convenient location of trip coils making calibration adjustment accessible.

Breaker opens by gravity, assisted by tension springs and is equipped with bumpers to absorb the shock.

Open position is maintained by gravity.

Inability to hold full-automatic breaker in closed position against predetermined conditions of tripping.

Strong tanks and tank supports.

Tanks removable without disturbing operating mechanism or contacts, thereby making inspection easy.

Ample air space at tank top to allow for gas expansion.

Dust-proof and drip-proof, but not weather-proof.

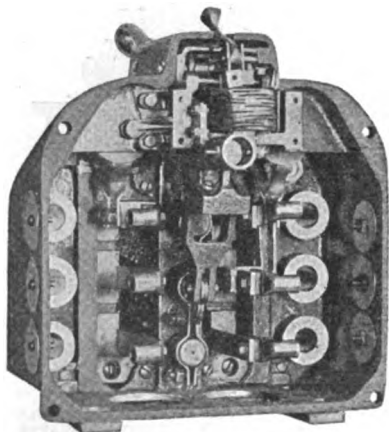


FIG. 4—TOP VIEW OF TYPE F-10 OIL CIRCUIT-BREAKER WITH COVER REMOVED TO SHOW UNDERVOLTAGE RELEASE ATTACHMENT AND OPERATING LEVER, TERMINALS, ETC.

Operation

See also pages on "Oil Circuit-Breakers—General Information."

**Manual Operation**—All type F-10 breakers are manually operated.

The type F-10 breakers, as listed, are all non-automatic. The breaker is held in the closed position by a hardened steel latch engaging a hardened steel roller. This roller is carried on the trigger so that when the trip coil is energized the trigger is raised, disengaging the latch and allowing the breaker to open. When the breaker is used non-

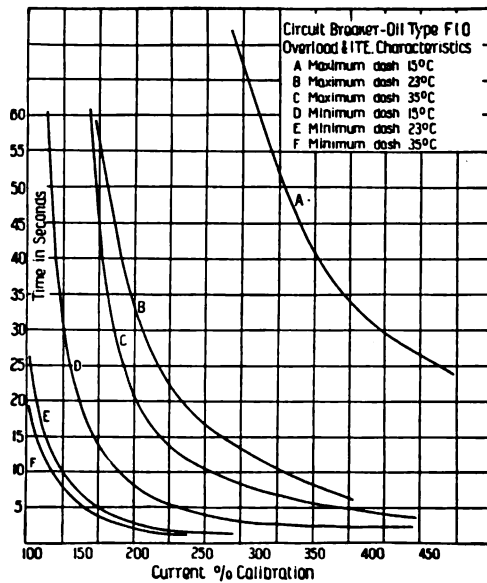


FIG. 5—TIME OVERLOAD CHARACTERISTICS OF THE INVERSE TIME-LIMIT ATTACHMENT USED IN CONNECTION WITH THE TYPE F-10 OIL CIRCUIT-BREAKER WHEN EQUIPPED WITH STANDARD DASHPOT OIL AS SUPPLIED WITH DASHPOTS

automatic, the breaker is tripped by raising the closing handle. When the breaker is in the closed position the operating handle is vertical. When the breaker is open the handle is raised slightly, thus it is possible to tell the position of the contacts by the position of the handle.

**Automatic operation** is obtained by the addition of one or more automatic trip-attachments listed and described under the "Auxiliaries for Type F-10 Oil Circuit-Breakers" and by the addition of the necessary current or potential transformer where needed. All automatic breakers are full-automatic, that is, it is impossible to hold a breaker in the closed position when a predetermined tripping condition exists.

All circuit-breakers are equipped with series-current overload trip coils for use on applications up to 300 amperes, but where desired the 5-ampere series-trip coil can be used in connection with current transformers and relays, with the transformers mounted separately from the breaker.

## TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

## Construction

The breaker frame or housing is made of heavy cast iron. The breakers are supported by bolting the breaker frame proper to the wall or any flat vertical surface. The breakers, as supplied, have openings for taking the leads downward at the two sides of the breaker. Three holes are provided in each frame side, so that the leads may be taken horizontally from the breaker when desired. Washers are provided which are interchangeable with the insulators so that the set of holes not in use can be covered. Holes are provided in the back of the breaker frame and covered with washers so that a conduit box, when desirable, can be used with the breaker.

Single tank per breaker construction containing all poles is used. The heavy sheet iron rectangular oil tanks are made with all seams lap-welded, the bottom being flanged and welded on the outside of the tank sides. As sufficient space is allowed in

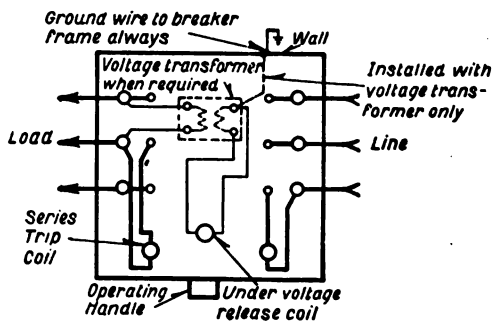


FIG. 6—SCHEMATIC DIAGRAM OF CONNECTIONS FOR F-10 OIL CIRCUIT-BREAKER WITH HAND-BREAKER WITH AUTOMATIC-RESET UNDERVOLTAGE RELEASE ATTACHMENT

the tanks for oil expansion and bubbles caused by the arc gases, no insulating lining material is used.

The method of fastening the tank to the frame by three bolts supplied with wing nuts while very secure permits easy removal of the tanks for the purpose of inspection and repair. The supporting framework of the breaker unit has a flange which encloses the upper end of the tank when in place, thus preventing distortion of the tank due to internal pressure.

The tanks are deep to allow an ample space above the oil which acts as an expansion chamber for the arc gases and reduces the slopping of the oil from internal disturbances. The gases are vented through the clearance between the operating rods and the breaker framework, and between the operating handles and the framework. The lifting lever attached to the crossbar clamps the specially constructed wood operating rod and it is operated through a toggle so constructed that the pressure on the contacts at the end of the moving contacts' travel is overcome easily by the operator during the closing operation.

The copper strap terminal studs with the stationary contacts on the lower end are bolted to a

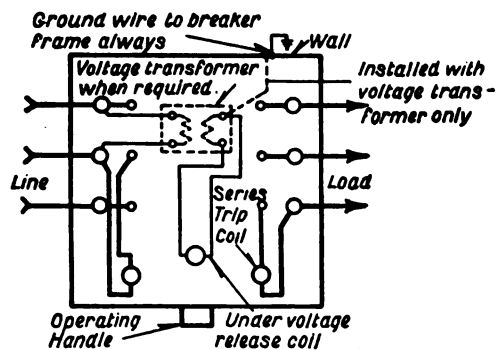


FIG. 7—SCHEMATIC DIAGRAM OF CONNECTIONS FOR F-10 OIL CIRCUIT-BREAKER WITH AUTOMATIC-RESET UNDERVOLTAGE RELEASE ATTACHMENT

wooden base which is bolted in turn to the breaker frame.

Copper tube terminals are supplied on all breakers and are clamped on the copper strap studs by bolts. On special order special terminals can be supplied at an increase in price. Westinghouse-Frankel Solderless Connectors can be used for this service. For prices see pages on these connectors. No allowance is made for the omission of the terminal regularly supplied with the breaker when special terminals are ordered since the special terminals are shipped as an additional item.

The moving wedge contact and stationary contact fingers are of an improved controller type. These contacts are the same as those used on the type F-11 oil circuit-breakers. Refer to that section for their description.

The construction of this breaker is such that the entire equipment may be assembled, lined up and the contacts and auxiliaries adjusted either below or above the frame before the tank or cover is placed in position. This feature of accessibility in securing quick and accurate replacements and adjustments.

## Auxiliaries

See also pages on "Oil Circuit-Breakers—General Information" and pages on "Switchboard Accessories."

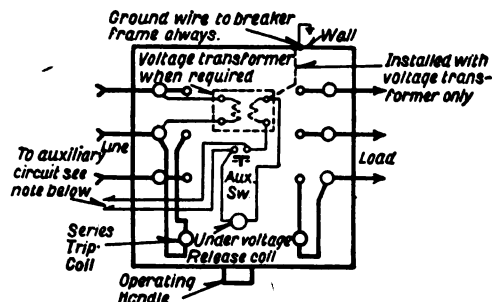


FIG. 8—SCHEMATIC DIAGRAM OF CONNECTIONS FOR F-10 OIL CIRCUIT-BREAKER WITH AUTOMATIC-RESET UNDERVOLTAGE RELEASE ATTACHMENT AND ELECTRIC LOCKOUT DEVICE WITH SIGNAL SWITCH

Note:—This circuit leads to the auxiliary circuit closing contacts on the motor controller: circuit closing push-button, etc. It is impossible to close the breaker until this circuit is completed, thus energizing the undervoltage release coil. After the breaker is closed, the auxiliary switch completes the holding (undervoltage release coil) circuit.

## TYPE F-10 OIL CIRCUIT-BREAKERS—Continued



FIG. 9—TYPICAL SERIES-CURRENT OVERLOAD TRIP COIL COMPLETE

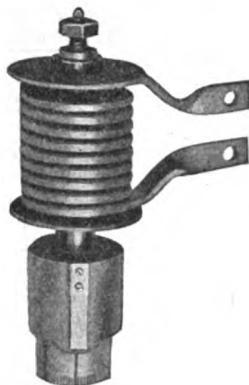


FIG. 10—TYPICAL SERIES-CURRENT OVERLOAD TRIP COIL WITH INVERSE-TIME-LIMIT ATTACHMENT COMPLETE

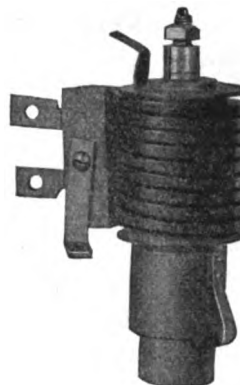


FIG. 11—DOUBLE SERIES-CURRENT OVERLOAD TRIP COIL WITH INVERSE-TIME-LIMIT ATTACHMENT COMPLETE

**Series current overload trip coil attachment,** Fig. 9, is placed in the breaker housing in order to make the breakers automatic. The attachment complete with trip coil, magnetic circuit and tripping details slips into the upper front part of the housing and is retained by a single nut. The calibration adjustment is on the outside of the breaker. The calibration of the trip coil magnetic circuit is from 100% to 180% of the attachment rating. Calibration is made on both 60 and 25 cycles. The connection to the trip coil is made by removing the jumpers from the left middle and right front studs and using them as connectors for the left hand coil. The right hand coil connects directly to the stud without connectors. This arrangement makes it very simple to change the tripping devices by the use of other coils or by the use of other coils with inverse-time-limit attachments.

**Series current overload trip coil with inverse-time-limit attachment,** Fig. 10, is furnished complete with dashpot, trip coil, magnetic circuit and tripping details. This device is added to the breaker by inserting the complete device into the breaker housing and by tightening one nut. The connection of the trip coil proper is made the same as in the case of the series current trip attachments. The inverse-time-limit dashpot and the trip coil calibrations are outside of the breaker housing and, therefore, readily accessible for adjustment. The calibration is made on both 60 and 25 cycles.

The **inverse-time-limit attachment** is of the piston type. The calibration (tripping point) is stamped on the side of the dashpot and is varied by screwing the pot in or out of the cover. The time is varied by changing the number of holes in the bottom of the piston uncovered by the diaphragm. Instantaneous resetting is possible due to the check valve action of the washer. The tripping time varies inversely with the amount of the overload and directly with the variation in the viscosity of the oil. Fig. 5 shows the variation of the time with the variation of the overload and the effect of change in temperature on the standard dashpot oil as supplied for the dashpots.

**Double series current overload trip coil with inverse-time-limit attachment,** Fig. 11, is furnished complete with dashpot, double trip coil (calibrated for 25 and 125 amperes nominal), magnetic circuit and tripping details. This device is added to the breaker by inserting the complete device into the breaker housing and by tightening one nut. The connections are made as indicated in the note under table 1, and in the schematic diagram of connections Fig. 12.

The **undervoltage release attachment** is attached to the inside of the breaker housing by four bolts and can be used with either the non-automatic or automatic breakers. This attachment will trip the breaker when the voltage falls to approximately fifty per cent (50%) of its rated voltage. This attachment may be connected to the line side of breaker only when an auxiliary signal switch is used to open the undervoltage control circuit when the breaker opens.

The **hand-reset undervoltage release attachment,** Fig. 13, is connected as shown in Fig. 6 with leads to the attachment connected across one phase on the load side of the breaker. The attachment is retrieved, while closing the breaker, by pushing on a small cast knob which projects through the breaker frame and above the operating handle on the front of the breaker.

The **automatic-reset undervoltage release attachment,** and electric lock-out device is shown in Fig. 14.

Fig. 7 shows the method of connecting the attachment as an **automatic reset undervoltage release.** It is to be noted that the attachment must be connected to the line side of the breaker. The attachment is retrieved automatically by the opening of the breaker.

Fig. 8 shows the method of connecting the attachment as a combined **electric lock-out device and undervoltage release.** The attachment must be connected to the line side of the breaker and is

## TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

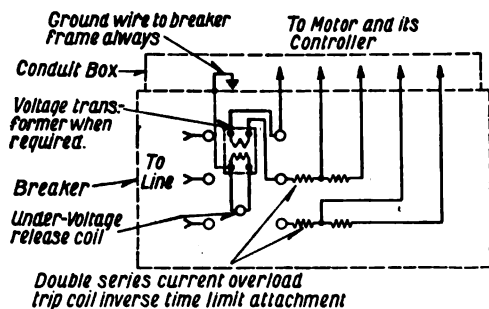


FIG. 12—SCHEMATIC DIAGRAM OF CONNECTIONS FOR THE SPECIAL F-10 OIL CIRCUIT-BREAKER WITH DOUBLE SERIES-CURRENT OVERLOAD TRIP COIL ATTACHMENT

automatically retrieved as the breaker opens. A lug on the main cross bar engages a lug on the under-voltage attachment and forces its moving core or armature to the "closed position" where the armature is held by line voltage. The breaker cannot be closed unless the undervoltage coil is energized. When the breaker is controlling a motor, this means that the motor starting device must be in the proper

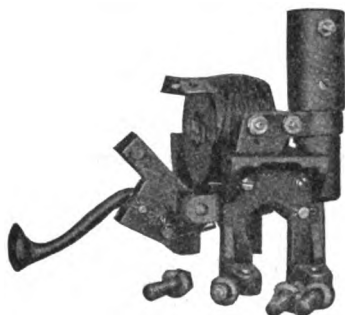


FIG. 13—HAND-RESET UNDERVOLTAGE RELEASE ATTACHMENT COMPLETE WITH SIGNAL SWITCH ATTACHED

starting position. After the breaker is closed the auxiliary switch completes the circuit through the undervoltage coil.

The undervoltage release attachments are self-contained up to and including 600 volts. For voltages between 600 and 2500 separate voltage transformers are required for use in connection with the 110-volt attachment. For 2500-volt applications a self-contained voltage transformer for mounting in the breaker frame is supplied for use in connection with the 110-volt attachment—see data under voltage transformers which follows.

**Signal Switch**—The signal switch, Fig. 15, is a single-pole single-throw switch which makes contact when the breaker is closed. The switch mounts on the undervoltage release mechanism or electric lockout mechanism and can be supplied without either of these devices on special order.

**An ammeter-mounting cover**, for mounting the self-contained type SM ammeter is listed for indoor service only. For illustration of application see

Fig. 18. These ammeter-mounting covers are dust-proof but not drip nor weather-proof. The type SM self-contained ammeter up to and including 200 amperes will be furnished and must be ordered separately. When ammeters of greater than 200 amperes capacity are required, the 5-ampere ammeter should be used in connection with the proper current transformer, both of which must be ordered separately. For complete data on ammeters and separate current transformers refer to Section 3-B of this catalogue titled "Westinghouse Instruments and Relays." The ammeter

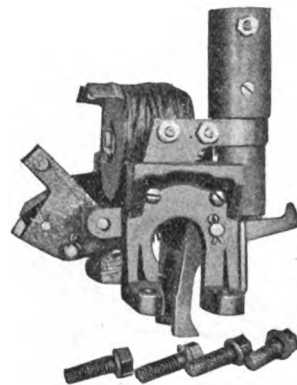


FIG. 14—AUTOMATIC-RESET UNDERVOLTAGE RELEASE ATTACHMENT AND ELECTRIC LOCKOUT DEVICE COMPLETE WITH SIGNAL SWITCH ATTACHED

selected should be such that it will not be injured by the maximum current that may pass through the breaker.

The conduit box, Fig. 16, is arranged for mounting on a flat vertical surface and supports the breaker from the rear by four bolts. Plates with knock-out holes are provided on the four sides of the box so that conduit connections may be brought in from any direction. Knock-out holes in the back of the breaker frame and in the front of the box allow the connections to be made to the breaker terminals.

The voltage transformer, Fig. 17, is self-contained and is furnished for use on both 25 and 60-cycle, 2500-volt service in connection with the 110-volt

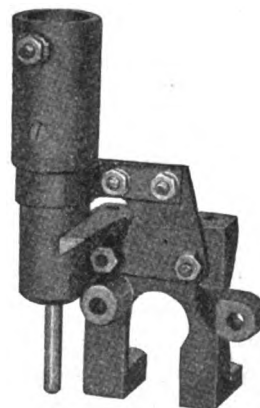


FIG. 15—SIGNAL SWITCH WITH MOUNTING BRACKET

TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

undervoltage release attachments. The transformer bolts onto the brackets of the undervoltage release attachment inside of the breaker housing—see Fig. 2.

Prices

Style number and list price include the non-automatic breaker with oil as described (for automatic breakers add trip coil and transformers from the listing of auxiliaries as needed). These breakers do not have excessive insulation and should not be installed on lines subject to surges above the insulation test values given in rule 7323 of the April, 1921 edition of the "Standard Rules of the A. I. E. E." unless protected by lightning arresters or other surge protective devices.

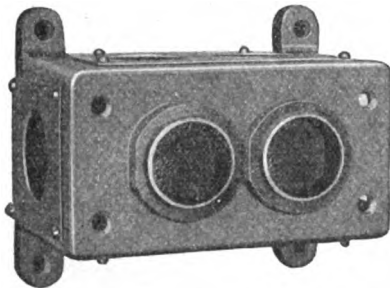


FIG. 16—CONDUIT BOX FOR TYPE F-10 OIL CIRCUIT-BREAKER

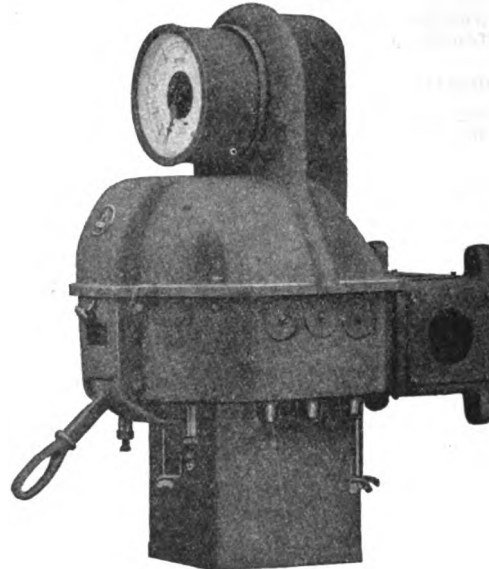


FIG. 18—TYPE F-10 OIL CIRCUIT BREAKER EQUIPPED WITH AMMETER MOUNTING COVER AND MOUNTED ON CONDUIT BOX

TABLE I

Type F-10, Manually Operated, Single-Throw, Oil Circuit-Breakers†

Maximum Continuous Amperes	Maximum Volts	Number of Poles	Interrupting Capacity at Rated Volts in Amperes	Gal. Oil	APPROX.* WT. POUNDS		Style Number	List Price
					Net	Ship.		
200	2500	2	3000	2 1/4	80	116	362034	\$ 60 00
200	2500	3	3000	2 1/4	83	119	362032	75 00
†200	2500	3	3000	2 1/4	83	119	357232	75 00
300	750	2	12200	2 1/4	86	122	362035	108 00
300	750	3	12200	2 1/4	90	126	362033	135 00

\*Weight does not include oil. Net weight of oil is approximately 7 1/2 pounds per gallon; shipping weight of oil is approximately 9 pounds per gallon.

†This is a special breaker designed for controlling oil-well motors and similar applications. Provision is made for connecting both trip coils on the "dead" side of the breaker by running leads into the conduit box. The essential difference between this special breaker and the standard breaker is that the left middle stud of the standard breaker is interchanged with the right middle stud to form the special breaker. For a complete special breaker order:

- 1—Breaker Style No. 357232.
- 2—Double series-current overload trip coil inverse-time-limit attachments calibrated for both 25 and 125 amperes nominal Style No. 357233.
- 1—Hand reset undervoltage release attachment for proper voltage.
- 1—Conduit Box Style No. 362335.

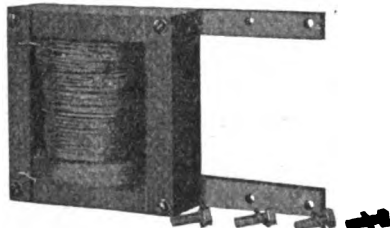


FIG. 17—VOLTAGE TRANSFORMER FOR 2500-VOLT 25 AND 60-CYCLE SERVICE FOR TYPE F-10 OIL CIRCUIT-BREAKER

‡These breakers are non-automatic. For automatic operation add the necessary attachments shown on pages 208 and 209.

TABLE II

Interrupting Capacity of Type F-10 Oil Circuit-Breakers

Rated Amperes	Rated Volts	Method of Control†	GREATEST CARRYING CAPACITY—AMPERES			MAXIMUM INTERRUPTING CAPACITY IN AMPERES AT SERVICE VOLTAGES ‡ OF	
			0.2 Sec.	1 Sec.	5 Sec.	750 V.	2500 V.
200	2500	D	100*	50*	25*	10,000	3000
300	750	D	100*	50*	25*	12,200	

\*Number of times coil rating.  
 †D=Direct Control.  
 ‡For other data and method of obtaining interrupting capacities at intermediate service voltages refer to pages on "Application of Oil Circuit-Breakers."  
 NOTE:—The carrying capacity of the series trip coils may prevent taking full advantage of interrupting capacity of breaker, also see pages on "Application of Oil Circuit-Breakers." Breaker reactance values given for the series trip type F-11 breakers are to be used for corresponding type F-10 breakers.

Order by Style Number



TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

TABLE III

Auxiliaries for Type F-10 Oil Circuit-Breakers

Amperes	APPROX. WT. POUNDS		Style No.	List Price
	Net	Ship.		
<b>Series Current Trip Coil Attachment Complete—2500 Volts Max. (Fig. 9)</b>				
5	2½	3½	362045	\$8 00
10	2½	3½	362046	8 00
15	2½	3½	362047	8 00
25	2½	3½	362048	8 00
50	2½	3½	362049	8 00
100	2½	3½	362050	8 00
150	2½	3½	362051	8 00
200	2½	3½	362052	8 00
300	2½	3½	†362295	8 00

Series Current Trip Coil with Inverse-Time-Limit Attachment Complete—2500 Volts Max. (Fig. 10)

Amperes	APPROX. WT. POUNDS		Style No.	List Price
	Net	Ship.		
5	3	3½	362296	\$15 00
10	3	3½	362297	15 00
15	3	3½	362298	15 00
25	3	3½	362299	15 00
50	3	3½	362300	15 00
*25-125	3	3½	357233	25 00
100	3	3½	362301	15 00
150	3	3½	362302	15 00
200	3	3½	362303	15 00
300	3	3½	†362304	15 00

\*Special double series-current overload trip coil for oil-well motor control.  
†For 750 volts only.

Undervoltage Release Attachment Complete

Volts	APPROX. WT. POUNDS		25 CYCLE		List Price	60 CYCLE		List Price
	Net	Ship.	Resistance	Style No.		Resistance	Style No.	
<b>Hand Reset (Fig. 13)</b>								
110	4	4¾	None	362312	\$20 00	None	362311	\$15 00
220	4	4¾	None	362313	20 00	None	362312	20 00
440	4	4¾	None	362314	20 00	None	362313	20 00
550	4	4¾	None	362315	20 00	None	362313	20 00
600	4	4¾	None	None	None	None	362314	20 00
2500	14	19¾	None	*		None	*	*

Automatic Reset or Electric Lockout Device (Fig. 14)

Volts	APPROX. WT. POUNDS		Resistance	Style No.	List Price	Resistance	Style No.	List Price
	Net	Ship.						
110	4	4¾	None	362317	\$43 25	None	362316	\$43 25
220	4	4¾	None	362318	43 25	None	362317	43 25
440	4	4¾	None	362319	43 25	None	362318	43 25
550	4	4¾	None	362320	43 25	None	362318	43 25
600	4	4¾	None	None	None	None	362319	43 25
2500	14	19¾	None	*		None	375853	*

\*Use 110-volt undervoltage release or electric lockout device in connection with voltage transformer Style No. 362334.

Miscellaneous Auxiliaries

Description	APPROX. WT. POUNDS		BREAKER Amp. Volts	Style No.	List Price
	Net	Ship.			
Voltage Transformers—2500 Volts, 25 and 60 cycles (Fig. 17)	10	15	all 2500	362334	\$13 30
Ammeter-Mounting Cover (Fig. 18)	35	45	all all	362338	26 70
Conduit Box (Fig. 16)	25	32	all all	362335	13 30
Signal Switch (For mounting on undervoltage or electric lockout attachments) (Figs. 13 and 14)	1	1¾	all all	362332	15 00
Signal Switch with mounting bracket (for use when the undervoltage or electric lockout attachments are not used) (Fig. 15)	2	3	all all	362333	20 00
One set of gaskets	1	1½	all all	375853	7 50

TYPE F-10 OIL CIRCUIT-BREAKERS—Continued

OUTLINE DIMENSIONS IN INCHES

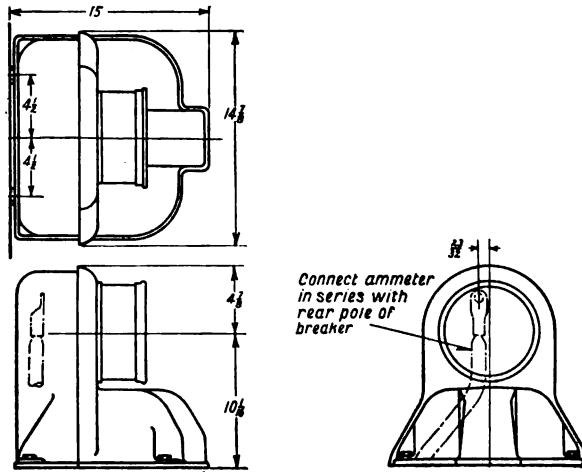


FIG. 19—AMMETER-MOUNTING COVER

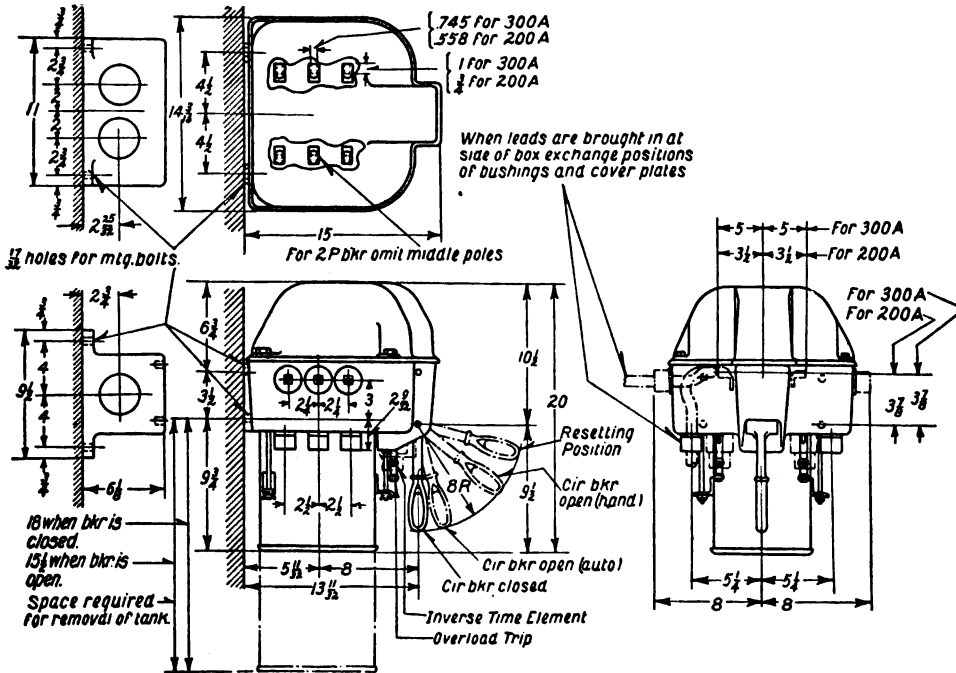


FIG. 20—TYPE F-10 OIL CIRCUIT-BREAKER

NOTE:—When the conduit box is used the breaker mounts on the box. The conduit holes are 3-inch for 2 1/4-inch conduit. These dimensions are for reference only. For official dimensions apply to nearest district office.

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS

MANUALLY AND ELECTRICALLY OPERATED, NON-AUTOMATIC AND AUTOMATIC, FOR INDOOR SERVICE, SINGLE AND DOUBLE-THROW

For Capacities up to 600 Amperes, 7500 Volts; 800 Amperes, 2500 Volts,  
Alternating-Current; Interrupting Capacities at Rated  
Voltage 2500 to 9000 Amperes

(Unless otherwise stated ratings are on a 60-cycle basis)

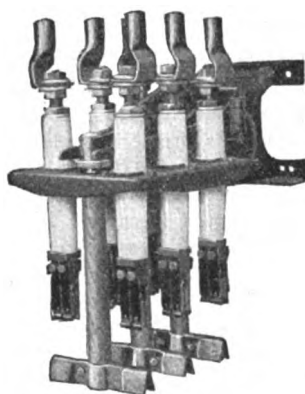


FIG. 1—TYPE F-11, INDOOR, THREE-POLE, SINGLE-THROW  
400-AMPERE, 2500-VOLT BREAKER UNIT

### Application

See also pages on "Application of Oil Circuit-Breakers."

The F-11 and F-22 oil circuit-breakers (superceding similar types F-1 and F-2 oil circuit-breakers) comprise a line of moderate capacity, non-automatic and automatic, manually-operated breakers for indoor service. The type F-22 breakers are in reality a continuation of the F-11 line of breakers but of larger capacity. The type F-11 breakers are made in the panel-mounting and remote-control, wall and

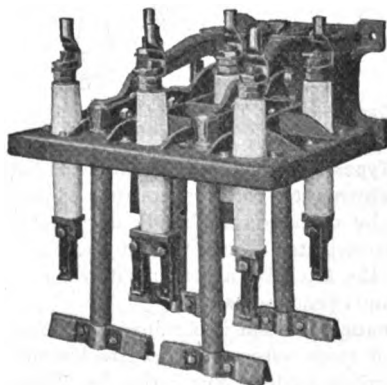


FIG. 2—TYPE F-11, INDOOR, TWO-POLE, DOUBLE-THROW  
200-AMPERE, 4500-VOLT BREAKER UNIT

pipe-mounting forms; for 200 amperes, 4500-volt service and 400 amperes 2500-volt service, two and three-pole, single and double-throw.

The type F-22 breakers are made in the panel mounting, and remote control, wall and pipe mounting forms; for 400 and 600 amperes, 7500-volt service, and 800 amperes, 2500-volt service; one, two, three and four pole, single-throw, common frame or multiple single pole, manually and electrically operated. The types F-11 and F-22 breakers are not listed for panel frame mounting, as the breaker frame when bolted to the panel is so designed as to give a clearance of approximately seven inches between the breaker tank and the rear of the panel. This gives ample space for incoming and outgoing leads.

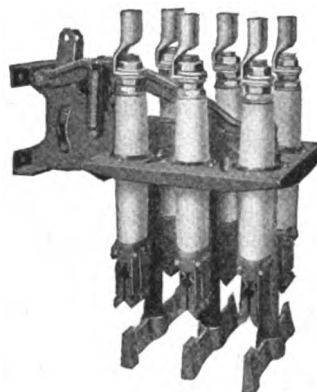


FIG. 3—TYPE F-22, INDOOR, THREE-POLE, SINGLE-THROW  
600-AMPERE, 7500-VOLT BREAKER UNIT

### Distinctive Features

Among the features that distinguish the types F-11 and F-22 breakers are:

A novel design of contact on the type F-11 breaker so shaped that different portions of the same contact surface act as the main current-carrying contact and as the arcing contact, but the arcing contact surface is so located as to prevent arcing on the main current-carrying contact surface;

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

Highly efficient form of wedge and finger contact on the type F-22 breakers with auxiliary arcing contacts on the moving element; the stationary element is shaped and located so that different portions of the same contact surface act as the main current carrying contact and as the arcing contact thus preventing arcing on the main contact surface;

Flared wedge contacts under heavy pressure;

Submersion and opening of all contacts under oil;

The ease of changing from non-automatic to automatic breakers by the addition of the various overload devices only;

The ease of changing from panel-mounting breaker to a remote-control, wall-mounting breaker by merely the addition of bell cranks or to a remote-control, pipe-mounting breaker by the addition of bell cranks and pipe-mounting brackets;

The breaker opens by gravity, assisted by tension springs and is equipped with bumpers to absorb the shock:

The open position is maintained by gravity;

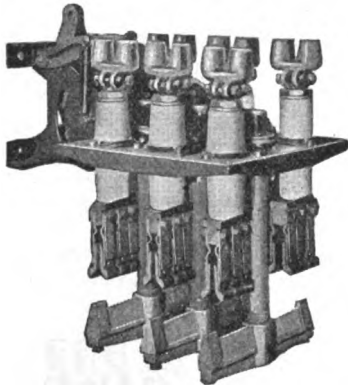


FIG. 4—TYPE F-22, INDOOR, THREE-POLE, SINGLE-THROW 800-AMPERE, 2500-VOLT BREAKER UNIT

Inability to hold full-automatic breaker in closed position against predetermined conditions of tripping;

Strong tanks and tank supports;

Tanks removable without disturbing operating mechanism or contacts, thereby making inspection easy;

Ample air space at tank top to allow for gas expansion;

Poles isolated by insulating tank lining and partitions.

### Operation

See also pages on "Oil Circuit-Breakers.—General Information."

**Manual Operation**—The coverplate containing the operating handle is supplied for mounting on a panel or panel bracket. Types F-11 and F-22 direct-control panel-mounting and remote-control wall-mounting breakers are listed. The remote-control wall-mounting breakers as listed are for upward pull with bell cranks either above or below the floor. Pipe-mounting remote-control breakers are secured by the addition of pipe-mounting brackets. Where necessary the mechanisms can be changed easily

from the standard arrangement of upward push to downward pull without additional material.

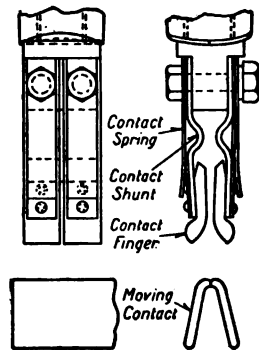


FIG. 5—DETAILS OF THE TYPE F-11 CONTACTS USED ON THE 400-AMPERE, 2500-VOLT BREAKER

**Electrical Operation**—The type F-22 breakers are regularly supplied for solenoid operation. The solenoid operating mechanism is a separate unit intended to mount directly behind the breaker on a wall or pipe structure. It may be mounted on the floor below the breaker. This mechanism is full-automatic, that is, it cannot be held in the closed position with an overload on the line. It is equipped with a shunt-trip coil and a two-pole, double-throw, signal switch for cutting out the shunt-trip coil after it has functioned and for controlling the signal lamps. The mechanism is wired with the closing and trip-coil leads brought to a terminal board. The user has only to connect control wires to the binding posts on this terminal board to complete the control circuit.

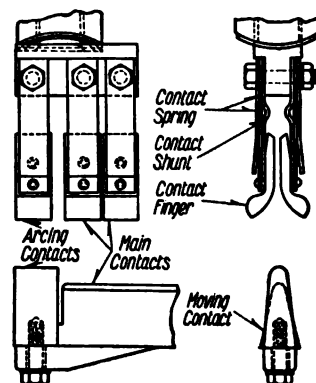


FIG. 6—DETAILS OF THE TYPE F-22 CONTACTS USED ON THE 600-AMPERE, 7500-VOLT BREAKER

The Types F-11 and F-22 Breakers as listed are all non-automatic. The breakers are held in a closed position by a latch on the handle engaging a notch in the coverplate. The lifting of the handle disengages the latch by a movement of the jointed handle and opens the breaker.

**Automatic operation** is obtained by the addition of one or more automatic trip-attachments listed and described under "Auxiliaries for Types F-11 and F-22 Oil Circuit Breakers," and by the addition of necessary relays and current or potential trans-

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

formers where needed. All automatic breakers are full-automatic, that is, it is impossible to hold a breaker in the closed position when a predetermined tripping condition exists.

These circuit-breakers can be equipped with either series-current overload-trip coils for use on applications up to 200 amperes 750 volts, or with transformer overload-trip coils for use on voltages up to 7500.

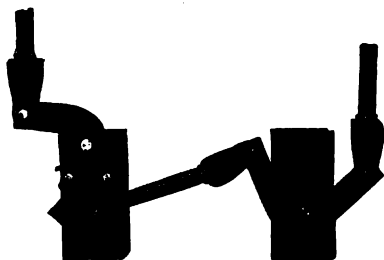


FIG. 7.—ONE PAIR OF BELL CRANKS SHOWING PIPE (FURNISHED BY USER) FOR CONNECTIONS

All single-throw breakers are furnished with coverplates which have space for two coils. Both the two-pole and the three-pole, double-throw, type F-11 breakers are furnished with coverplates which have a space for three coils. It is standard practice to use one over-load-current trip-coil on single-pole and two-pole breakers, and two over-load-current trip-coils on three-pole and four-pole breakers.

NOTE:—In the three-coil coverplate, due to the space required for lead-clearances, three series-current over-load trip coils cannot be used; but two series-current overload trip-coils and one shunt trip-coil can be used.

### Construction

The breaker frame of the single-throw two and three-pole breakers is made up of punched and formed sheet steel. The breaker frame of the double-throw type F-11 breakers and of the single-throw, single and four-pole type F-22 breakers is made of heavy cast iron. The breakers are supported by bolting the breaker frame proper to the panel, the panel bracket, a flat vertical surface, or to 1¼-inch pipe by the addition of two pipe-mounting brackets.

Single-tank per breaker construction containing all poles is used on these breakers except for the multiple single-pole type. The multiple single-pole breakers have one tank per pole and frame. The heavy sheet-iron rectangular oil tanks are made with all seams lap-welded, the bottom being flanged and welded on the outside of the tank sides. As an additional protection from arcing, insulating material forms separate compartments for each pole.

The method of fastening the tank to the frame by wing nuts screwed onto lugs riveted onto the tanks, while very secure, permits easy removal for the purpose of inspection and repair. The sup-

porting frame of the breaker unit has a flange which encloses the upper end of the tank when in place, thus preventing distortion of the tank under internal pressure.

The tanks are deep to allow ample space above the oil level to act as an expansion chamber for the arc gases and to reduce slopping of the oil from internal disturbances. The gases are vented through the clearance between the operating rods and the frame.

The tank lining and the insulating material forming the separate compartments are of treated wood.

The lifting lever attached to the punched cross bar clamps the specially treated wood operating rods, and is operated through a toggle so constructed that the pressure on the contacts at the end of the moving contacts' travel is easily overcome by the operator during the closing operation.

The terminal studs with stationary contacts on the lower end are supported by one-piece vertical pillar-type porcelain bushings clamped to the framework, by three bolts spaced 120 degrees apart. The studs are clamped in these insulators. This construction avoids the use of babbitt and cement, and thus reduces the time and labor of maintenance. Lock washers are used on the clamping bolts and current-carrying parts to prevent them from loosening by vibration or hammer blows, which might occur in the operation of the breaker.

Copper tube terminals are supplied on the 200, 400 and 600-ampere breakers. These one piece terminals are clamped onto the stud by two flange nuts, one above, the other below the terminal.



FIG. 8.—TYPE F-11, INDOOR, WALL-MOUNTING, MANUALLY-OPERATED, THREE-POLE, SINGLE-HANDLE, SINGLE-THROW, 200-AMPERE, 4500-VOLT, REMOTE CONTROL BREAKER, WITH ONE SUPPORTING LEG AND BRACE OF COVERPLATE-SUPPORTING FRAMEWORK REMOVED SO AS TO SHOW DETAILS OF CONSTRUCTION

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

Cast terminals providing for two cables per stud, are supplied on the 800-ampere breakers. These cast terminals are clamped to the studs by bolts

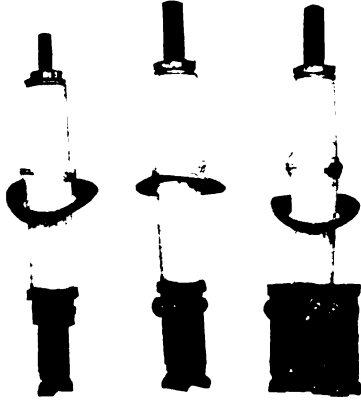


FIG. 9—TYPE F-11 STATIONARY CONTACT PILLAR UNITS—LEFT TO RIGHT, 200-AMPERE, 4500-VOLT, SINGLE OR DOUBLE-THROW; 400-AMPERE, 2500-VOLT, SINGLE OR DOUBLE-THROW; AND 200-AMPERE, 4500-VOLT, (CENTER-CONTACT) DOUBLE-THROW

provided with nuts and lock washers. On special orders, special terminals can be supplied, at an increase in price. For special terminals or contact nuts, see data under "Switchboard Details" or section on "Westinghouse-Frankel Solderless Connectors."

NOTE:—No allowance is made for the omission of the terminals regularly supplied with the breaker when special terminals are ordered, since the special terminals are shipped as an additional item.

The moving contacts are of an improved wedge type. In the type F-11 breaker the punched copper contacts or blades are bolted and pinned to the wedge-shaped end of the operating rod, thus effectively preventing slipping.

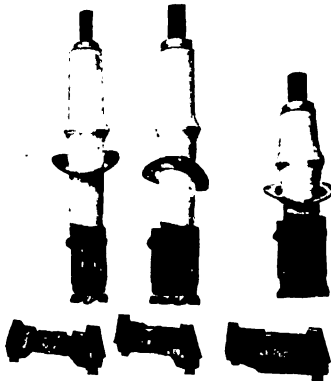


FIG. 10—TYPE F-22 STATIONARY CONTACT PILLAR UNITS WITH TERMINAL CLAMPS AND MOVING CONTACTS—LEFT TO RIGHT, 400-AMPERE, 7500-VOLT; 600-AMPERE, 7500-VOLT; AND 800-AMPERE, 2500-VOLTS

The moving contacts of the type F-22 breakers are heavy copper castings with renewable arcing tips. These arcing tips are of solid copper with high thermal capacity which reduces burning from arcing to a minimum. The cast copper contacts or blades are screwed to the threaded end of

the wood operating rod, and effectively prevented from turning by a wood screw used as a pin.

The stationary contacts consist of fingers of the "controller" type arranged in pairs facing each other so as to make perfect contact on the two surfaces of the moving contact wedge when the breaker is closed. The contact tips on the end of the fingers are supported on the ends of thin flat steel springs permitting the contact to move in all directions and to automatically align itself on the wedge, thus insuring that the full carrying capacity of the contacts is always available. This spring is shunted by a liberal copper-leaf shunt to conduct the current from the tips to the terminal stud. The contact pressure is obtained by a second and heavier flat steel spring which rests on a round rivet head and which applies pressure over the center of the contact tip of the finger.

One or more pairs of fingers are used according to the capacity of the breakers. (See illustrations.)

The arcing of the contacts, on opening either the type F-11 or F-22 breakers is kept away from the main current-carrying surfaces (of the contacts). In the case of the type F-11 breaker the arcing takes place on the same parts, but is prevented from

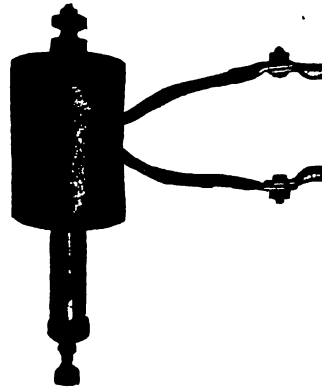


FIG. 11—A TYPICAL SERIES OR TRANSFORMER TRIP-COIL ATTACHMENT OR SHUNT-TRIP ATTACHMENT COMPLETE

burning the main current carrying surfaces by the mechanical construction of the contacts and the blowout action of the field caused by the current passing through the breaker. The construction of the contacts of the type F-11 breaker is such that the arcing takes place between the top outside edges of the moving contact and the lower outside edges of the stationary contacts, which are flared to form arcing tips.

In the type F-22 breaker the arcing takes place only on the renewable arcing tip and its corresponding fingers on the stationary contact. This arcing is confined to the top edges of the moving arcing tip contact and the lower edges of the outside stationary contact fingers, which are flared to form arcing tips.

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

The contacts of both breakers are kept clean by the rubbing of one contact upon the other when the breaker is operated.

The construction is such that the entire breaker may be assembled and lined up and the contacts adjusted from under the frame before placing the tank in position. This feature of accessibility of contacts is of very material advantage in securing quick and accurate repairs and adjustments.

**Solenoid Operating Mechanism**—The solenoid mechanism for use with the type F-22 breaker has a cast iron frame with mounting feet for bolting to the floor and holes for bolting to the wall or a flat vertical surface. This casting has boxes for the closing and shunt-trip coils. The moving core of the closing solenoid pulls downward on the lower of the two levers. This lever is latched to an

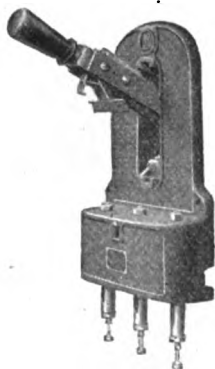


FIG. 12—SINGLE-THROW, THREE-COIL COVERPLATE WITH THREE TRANSFORMER TRIP-COIL ATTACHMENTS

upper lever to which the breaker pull rod is attached. In case the mechanism is closed on a short circuit, the lower lever is unlatched from the upper lever by the trip coil and the breaker opens even though the closing solenoid remains energized.

The mechanism is provided with a two-pole, double-throw, switch for opening the shunt-trip coil circuit after it has functioned and for controlling the signal lamps. The hinge and break jaws of the knife-blade-contact signal switch are mounted on a wooden panel at the front of the breaker-operating mechanism in a most accessible position. These jaws are rear-connected, the studs passing through the wooden panel to form a terminal board. Six points of the signal switch and two additional studs are provided to take all common methods of control wiring. The closing and trip coils of the breaker are wired to this control panel in the factory. The wires from the control circuit are brought to these terminal posts through an opening in the bottom of the cover that protects the live posts on the terminal board. This arrangement makes the wiring very neat and accessible.

When using this mechanism behind the breaker, which is the standard arrangement, it is fastened

to the wall or pipe bracket with the same bolts as the breaker. The mechanism connects to the breaker through  $\frac{3}{4}$ -inch wrought iron pipe and a bell-crank lever that is added to the standard breaker unit.

### Auxiliaries for Manually Operated Breakers

See also pages on "Oil Circuit-Breakers—General Information" and pages on "Switchboard Accessories."

**Series or Transformer-Current Trip-Attachment** is placed in the coverplate housing in order to make the breakers automatic. Either attachment complete with trip coil magnetic circuit and tripping details, slips into the coverplate housing and is retained by a single nut. This arrangement makes it very simple to change the tripping devices by the use of other coils with inverse-time-limit attachment or direct-trip attachment, etc.

The **calibration** of the 5-ampere tripping attachment is from 5 to 9 amperes; of the series trip attachment, the **calibration** is from 100 per cent to 180 per cent of the attachment rating. Wherever the transformer trip or series trip coils are used in connection with the inverse-time-limit attachment the calibration is as given in the foregoing sentence. When used with the direct trip attachment the calibration is determined by the relay setting but will function to trip the breaker if the relay operates any place in its calibration range.

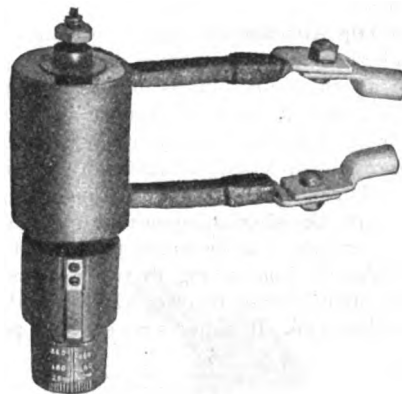


FIG. 13—A TYPICAL SERIES OR TRANSFORMER TRIP-COIL WITH INVERSE TIME-LIMIT ATTACHMENT COMPLETE

**Inverse-Time-Limit-Attachment** is furnished complete with dash pot, trip coil, magnet circuit and tripping details. This device is added to the coverplate by inserting the complete device into the coverplate housing, and by tightening one nut.

The inverse-time-limit attachment is of the piston type. The calibration is stamped on the side of the dashpot and is varied by screwing the pot in or out of the cover. The time is varied by changing the number of holes in the bottom of the piston un-

TYPES F-11 AND F-22 CIRCUIT-BREAKERS—Continued

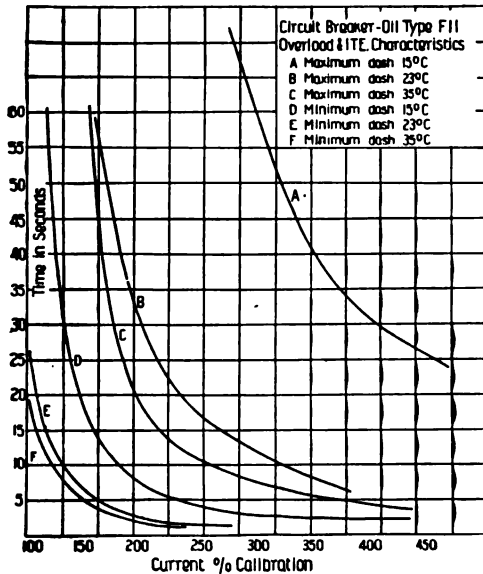


FIG. 14—TIME OVERLOAD CHARACTERISTICS OF THE INVERSE-TIME-LIMIT ATTACHMENT USED IN CONNECTION WITH THE TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS WHEN EQUIPPED WITH STANDARD DASHPOT OIL AS SUPPLIED FOR THE DASHPOTS

covered by the diaphragm. Instantaneous resetting is possible due to the check-valve action of the washer. The time of tripping varies inversely with the amount of overload and directly with a variation in the viscosity of the oil. Figure 14 shows the variation of the time with the variation of the overload and the effect of change in temperature on the standard dashpot oil as supplied for the dashpots.

**Direct-Trip Attachments**—Conditions are often found where a reliable source of direct-current or separate alternating-current is not available for operating the shunt trip attachment of alternating-current breakers through contact-closing relays; for this purpose the direct-trip attachment is provided. This attachment consists of a retaining magnet mounted with the alternating-current trip magnet in the coverplate. It operates to prevent the tripping plunger from acting to trip the breaker until the circuit-closing relay operates to cut out the secondary coil. It requires no separate power

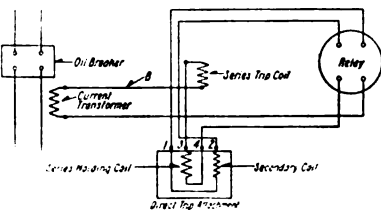


FIG. 15—SCHEMATIC DIAGRAM OF CONNECTIONS FOR DIRECT-TRIP ATTACHMENT OVERLOAD TRIP-COIL, TYPE CO RELAY, AND CURRENT TRANSFORMER FOR SINGLE-PHASE CIRCUITS

circuit and is applicable with circuit-closing relays in place of series-trip relays of the circuit-opening type. It is operated from the same current transformers that operate the relays and the breaker-trip coils, and may be used with either overload relays or reverse-power relays. When there is any doubt as to the feasibility of a particular application of this attachment under any conditions whatever, it is preferable to submit the proposition to the Company for a recommendation.

Where reliable shunt tripping can be obtained, this will generally be considered preferable to the



FIG. 16—A TYPICAL TRANSFORMER TRIP-COIL WITH DIRECT TRIP ATTACHMENT COMPLETE

direct-trip attachment but the direct-trip attachment will generally be more satisfactory than any form of series-trip relay so far placed on the market

The direct-trip attachment is furnished complete with trip coil, series holding coil, secondary coil; magnetic circuit and tripping details. This device is added to the coverplate by inserting the complete attachment into the coverplate housing and tightening one nut.

**Shunt-Trip Attachment**—The magnetic circuit trip coil and tripping details of the shunt trip attachment are furnished for insertion in the coverplate in the same manner as the current trip coils. Where the closing of the contacts of a relay supplies current to the shunt-trip coil an auxiliary switch should be added to the circuit-breaker for the purpose of opening the shunt-trip coil circuit when the circuit-breaker opens, as the relay contacts are usually not adapted to opening the current taken by the shunt-trip coil.

**The Under-Voltage-Release Attachment** is held onto the front of the coverplate by the left hand (facing the coverplate) mounting bolts. This attachment will trip the breaker when the voltage falls to approximately 50% of the rated voltage.

The undervoltage release attachment must be connected so as to leave the coil demagnetized when the breaker is open.



## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

Where undervoltage protection only is required, the attachment without resistance should be used.

Where a relay, push button or other device is used to short circuit the undervoltage release

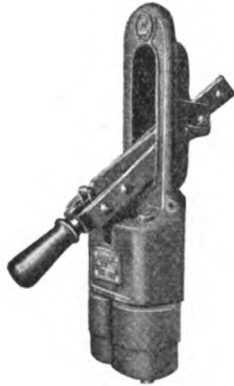


FIG. 17 SINGLE-HANDLE, SINGLE-THROW COVERPLATE COMPLETE WITH TWO TRANSFORMER TRIP-COIL, DIRECT-TRIP ATTACHMENTS

attachment coil and thereby trip the breaker, the attachment with resistance should be used. In this application the resistor remains in the circuit when the undervoltage coil is short circuited, thus preventing a short circuit of the control circuit.

The electric lockout device locks the breaker in the open position. The lockout device is mounted on the coverplate in the rear of the panel or panel bracket in such a way that a projection upon its hinged armature interferes with the tripping lever of the handle and thereby prevents the breaker from being closed until the magnet coil of the lockout device is energized. The energizing of the coil of the lockout device draws its hinged armature out of interference with this trip lever, thereby permitting the breaker to be closed.



FIG. 18—UNDERVOLTAGE RELEASE ATTACHMENT WITHOUT RESISTOR

The electric lockout device is for use with various interlocking control schemes, especially those for motors using a drum controller where the controller must be in the "off" position before closing the main line breaker; the device is also useful where a certain sequence of operation is desired.

The electric lockout device may be used on single handle coverplates and on either or both handles of double handle coverplates. The device cannot be used on a double handle coverplate at the same time that a mechanical sequence interlock is used except on special order and at additional expense.

When the electric lockout device and mechanical interlock are used, the casting of the electric lockout device is provided with a hole for the mechanical

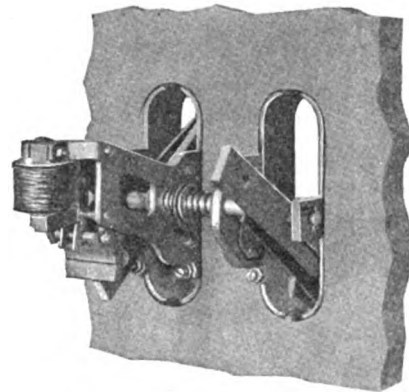


FIG. 19—ELECTRIC LOCKOUT DEVICE AND MECHANICAL INTERLOCK AS USED IN CONNECTION WITH A TWO-HANDLE, DOUBLE-THROW COVERPLATE

interlock bar and one bracket of the mechanical interlock should be discarded.

The mechanical sequence interlock is for use on double-throw, two-handle coverplates operating remote control breakers or on double-throw panel mounting type F-11 breakers. Its use assures the proper sequence of breaker operation when starting motors in connection with auto transformers. The mechanical sequence interlock provides that both handles of the coverplate will not be closed at the

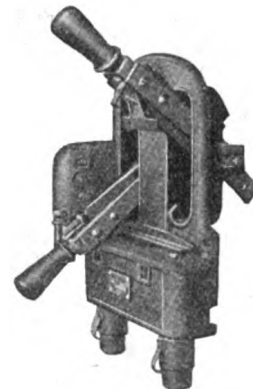


FIG. 20—TWO-HANDLE, DOUBLE-THROW COVERPLATE COMPLETE WITH TWO TRANSFORMER TRIP-COIL, INVERSE-TIME-LIMIT ATTACHMENTS AND ONE UNDER-VOLTAGE RELEASE ATTACHMENT

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

same time; in addition the device provides that the starting side of the breaker combination must be thrown completely in and then completely open before the running side can be thrown in or closed. The use of the device prevents the closing of the running side of the breaker combination first. The mechanical sequence interlock is mounted on the rear of the coverplate. The device cannot be used where the electric lockout device is mounted on one throw, that is, controls one of the handles of the coverplate but such an arrangement can be furnished on special order at additional expense.

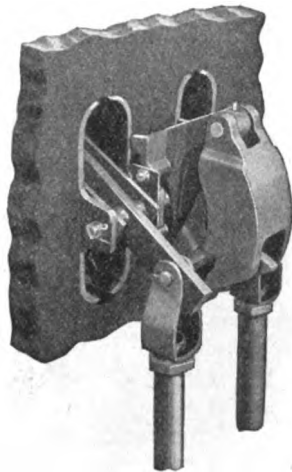


FIG. 21—MECHANICAL SEQUENCE INTERLOCK AS USED IN CONNECTION WITH A TWO-HANDLE, DOUBLE-THROW COVERPLATE, SHOWING THE BREAKER IN THE OPEN POSITION

The mechanical interlock is used in connection with two single-throw breakers controlled from a double throw, two handle coverplate or two single-throw, single handle coverplates in order to provide a double-throw breaker and prevent both throws of

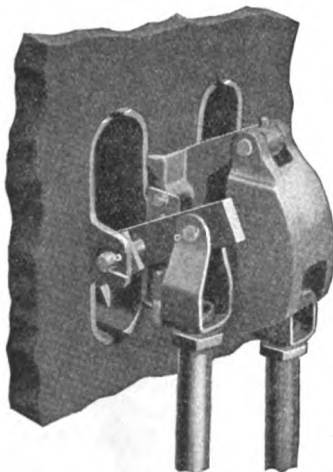


FIG. 22—MECHANICAL SEQUENCE INTERLOCK AS USED IN CONNECTION WITH A TWO-HANDLE, DOUBLE-THROW COVERPLATE, SHOWING ONE THROW OF THE BREAKER IN THE CLOSED POSITION

the breaker being closed at one time. The standard listed type F-11 double-throw breakers are equipped with the mechanical interlock as a part of the breaker.

For data relative to the use of the electric lockout device and the mechanical interlock at the same time refer to information given under the subject of "Electric Lockout Device."

The common trip mechanism is for use in connection with two single-throw panel-mounting breakers or two single-throw remote control breakers with single handle coverplates when it is desired to use two complete single-throw breakers

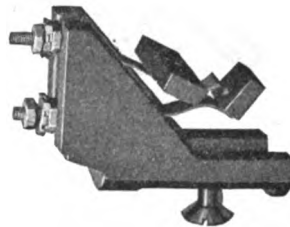


FIG. 23—BELL ALARM SWITCH

as a double-throw breaker. The common trip mechanism will cause the breaker which may be closed to open.

Panel Brackets are provided for mounting either the single-throw coverplate, the single-throw coverplate with breaker, the double-throw coverplate or the double-throw coverplate with the type F-11 double-throw breaker unit. In a certain sense the panel bracket takes the place of a slate or other panel for supporting coverplates and breaker units. These panel brackets must be supported with pipe or other structures.

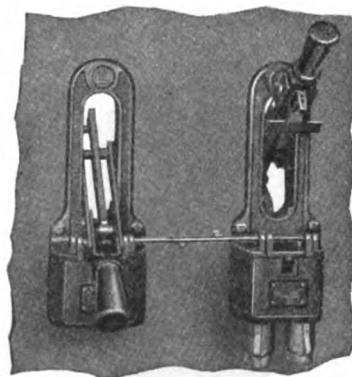


FIG. 24—COMMON TRIP ATTACHMENT AS USED IN CONNECTION WITH TWO SINGLE-HANDLE, SINGLE-THROW COVERPLATES; ONE COVERPLATE NON-AUTOMATIC, THE OTHER COVERPLATE EQUIPPED WITH AUTOMATIC-OVERLOAD AND INVERSE-TIME-LIMIT ATTACHMENTS

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

**Pipe-Mounting Brackets** are for mounting standard panel-mounting or wall-mounting breakers for remote-control directly on two parallel pipes, horizontally mounted, one 16 inches above the other. These parallel pipes (1¼-inch standard pipe size) are to be supplied by the user and may be supported in any manner desirable (by pipe or angle-iron framework properly braced) as no other support is required for the breaker.



FIG. 25—PIPE-MOUNTING BRACKET FOR BREAKER UNITS ONLY (TWO REQUIRED PER BREAKER)

This style of mounting provides a means of support accessible from all sides and makes unnecessary mounting the apparatus on the station wall. Two brackets are required per breaker. Style number and list price include one bracket complete with U-bolts for 1¼-inch pipe stringers.

**Auxiliary Switches** are double-pole, double-throw for actuating signal circuits—opening shunt-trip circuit, etc.

**Bell-Alarm Switches** are single-pole single-throw for actuating bell circuits only when a circuit-breaker opens automatically, but not when the breaker is opened by hand.

**Coverplates** are listed separately to enable users to replace two-coil coverplates by three-coil coverplates, and vice versa when desired.



FIG. 26—PANEL BRACKET FOR MOUNTING SINGLE-THROW, TWO-COIL COVERPLATE, OR PANEL-MOUNTING BREAKERS WITH TWO-COIL COVERPLATE

**Supporting Framework for Breaker or Coverplate**—The supporting framework for breakers or coverplates is of pipe construction. The supporting frame consists of vertical uprights with back braces and cross pipes so placed that it is possible to

mount: First, panel-mounting breakers by means of panel brackets; second, coverplates by means of panel brackets; and third, remote-control wall-mounting breakers by means of the pipe-mounting brackets.

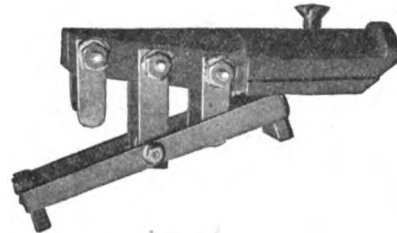


FIG. 27—AUXILIARY SWITCH

When desired, users can purchase blank panels which they can drill for meters or relays. These panels can be mounted on this supporting framework below the breaker or coverplate mounting, or above the breaker or coverplate mounting by extending the vertical support. These blank panels with mounting details are listed under "Switchboard Accessories."

**Bell Cranks**—The listed set of bell cranks consists of one bell crank and one accelerating device; that is, a bell crank, with accelerating springs, complete with the necessary rod ends and is assembled

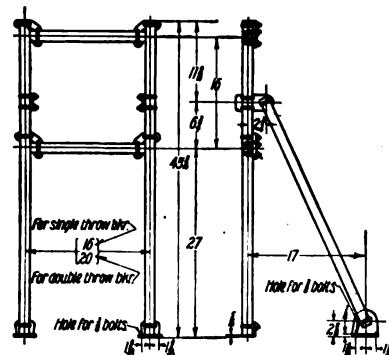


FIG. 28—SUPPORTING FRAMEWORK FOR THE TYPES F-11 or F-22 SINGLE-THROW BREAKER UNIT; PANEL-MOUNTING BREAKER; ANY COVERPLATE; OR TYPE F-11 DOUBLE-THROW BREAKER UNIT

for above floor-mounting. Both the bell crank and the accelerating device brackets have additional holes so that, by changing the bearing center, they may be adapted to below floor-mounting without additional material.

TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

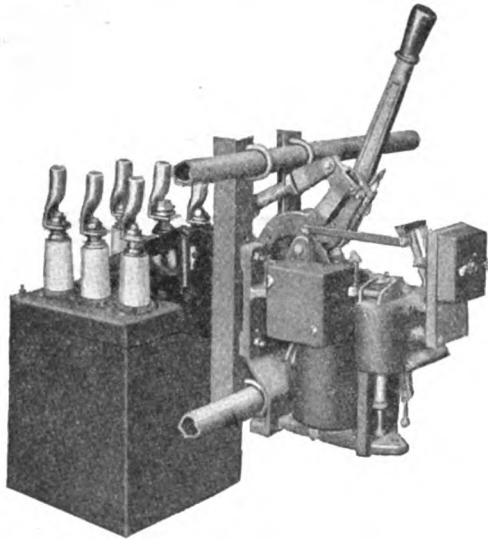


FIG. 29—F-22 OIL CIRCUIT-BREAKER WITH ELECTRIC OPERATING MECHANISM SHOWING ARRANGEMENT FOR PIPE MOUNTING

Auxiliaries for Electrically Operated Breakers

**Overload Trip Attachment**—Overload with inverse-time-limit, and direct trip attachments as described for hand-operated breaker are used with



FIG. 30—OVERLOAD TRIP ATTACHMENT FOR F-22 ELECTRICALLY-OPERATED BREAKER

electrically operated breakers. They consist of the same coils and tripping cores but have in addition a cast-iron coil box, which bolts to the side of the mechanism, and levers for transmitting the tripping blow to the mechanism trigger.

The undervoltage release attachment mounts on the side of the mechanism. It is automatic retrieving and must be connected to the live side of the line.

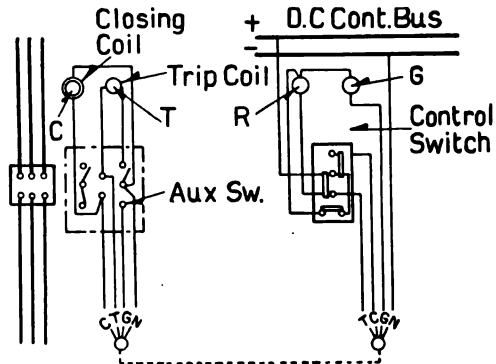


FIG. 31—DIAGRAM OF CONNECTIONS FOR F-22 ELECTRICALLY OPERATED BREAKER

This undervoltage release acts also as an electrical lock-out device which prevents the breaker from being closed until the undervoltage release is energized. Otherwise, this device functions as described for hand-operated breakers and uses the same coils and magnetic circuit.



FIG. 32—UNDERTAGE RELEASE ATTACHMENT FOR F-22 ELECTRICALLY OPERATED BREAKER

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

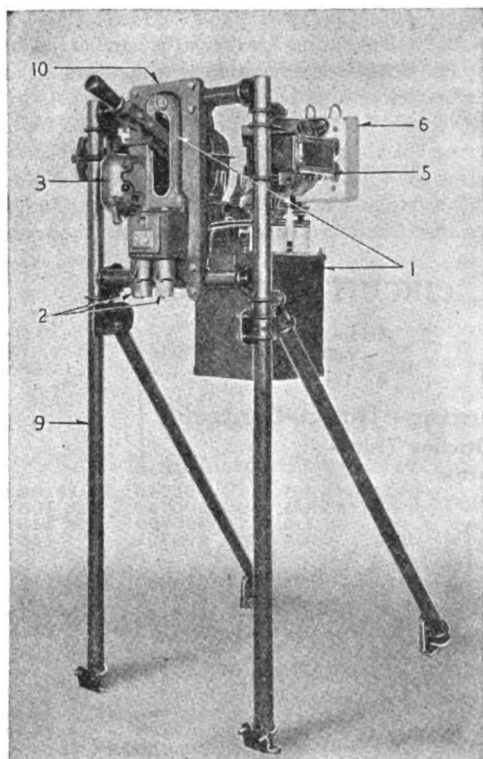


FIG. 33—FRONT VIEW OF THE TYPE F-11, 300-AMPERE, 2500-VOLT, THREE-POLE, SINGLE-THROW, PANEL-MOUNTING OIL CIRCUIT-BREAKER SWITCHING ASSEMBLY

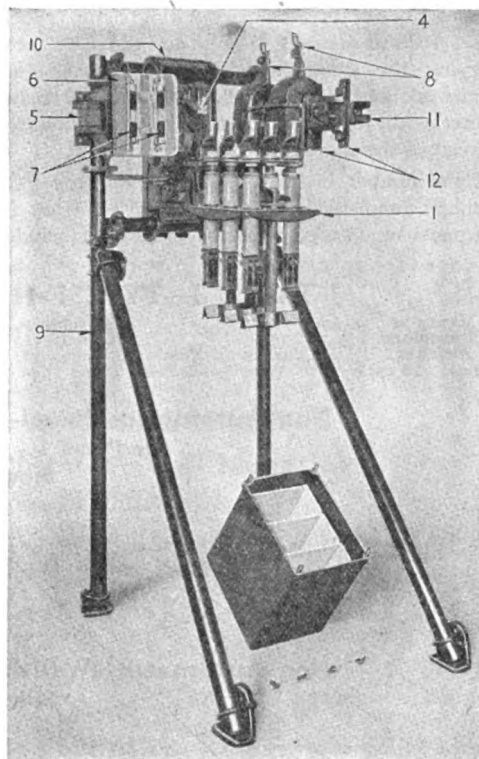


FIG. 34—REAR VIEW OF THE TYPE F-11, 300-AMPERE, 2500-VOLT, THREE-POLE, SINGLE-THROW, PANEL-MOUNTING, OIL CIRCUIT-BREAKER ASSEMBLY SHOWN IN FIG. 29

NOTE: Numerals in illustrations refer to the item numbers in the mounting combination example below.

The following is an example of one of many of the mounting combinations which can be worked out from catalogue listings:—

A customer desires a 300-ampere, 2500-volt, three-pole, single-throw, panel-mounting, manually-operated breaker equipped with undervoltage release, automatic overload, and inverse time limit attachments, with the necessary instrument transformers and mounting. For this application supply (see Figures 33 and 34) the following equipment:—

Item 1—1 Type F-11, 400-ampere, 2500-volt, three-pole, single-throw, panel-mounting, manually-operated breaker, Style No. 296751.

Item 2—2 Current transformer (5 ampere) overload trip coils and inverse time limit attachments, Style No. 296773.

Item 3—1 Undervoltage release attachment, 110 volts, 60 cycles, Style No. 296791.

Item 4—1 Auxiliary switch, Style No. 296797.

Item 5—1 Type VS potential transformer for 2300-volt, 60-cycle service, Style No. 303914, ratio 20/1 volts.

Item 6—1-2500-volt, two-pole, transformer fuse block, Style No. 117375.

Item 7—2-2500 volts,  $1\frac{1}{2}$  amperes, cartridge fuses, Style No. 32304.

Note:—Where necessary a current limiting resistor should be added to limit the short-circuit current to a value within the interrupting capacity of the fuse.

Item 8—2 Type KA current transformers for 60 cycle service, Style No. 125013, ratio 300/5 amperes.

Item 9—1 Supporting framework, Style No. 296799 (For supporting all material).

Item 10—1 Panel Bracket for supporting the coverplate and breaker unit, Style No. 300796.

Item 11—1 Universal mounting bracket, Style No. 216771 (21 inches long).

Item 12—4 Auxiliary mounting brackets, Style No. 72752.

Note:—Items 11 and 12 are for mounting the two current transformers.

TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

Item 13—Small instrument wiring clamps, Style No. 217623 (if desired), U-bolts and Stove bolts for carrying the small wiring, for supporting pipe framework and for attaching the potential transformer with the potential fuse blocks mounted thereon to the supporting framework.

Style number includes type F-11 or type F-22 breaker complete as described, with oil (that is, the panel mounting breaker style number includes

the non-automatic coverplate, the breaker unit and oil; the wall mounting breaker style number includes the non-automatic coverplate, the bell cranks and the breaker unit and oil;—if auxiliaries are desired, they should be added as per "Instructions for Ordering Oil Circuit Breakers," and in this section listing the types F-11 and F-22 breakers. Note:—The coverplates and bell cranks are listed among the miscellaneous auxiliaries for convenience only).

TABLE I—TYPE F-11 OIL CIRCUIT-BREAKERS†

MAXIMUM CONTINUOUS AMPERES		Maximum Volts	Number of Poles	Interrupting Capacity in Amps. at Rated Volts	Gal. Oil	APPROX. † WT., POUNDS		Style Number	List Price
60 cycle	25 cycle					Net	Ship.		
<b>Non-Automatic—Panel-Mounting—Direct-Control ¶</b>									
<b>On Panel 1½ or 2-Inches Thick</b>									
<b>Single-Throw</b>									
200	200	4500	2	3200	3¼	92	105	296748	\$ 84 00
200	200	4500	3	3200	3½	100	115	296749	105 00
400	500	2500	2	6500	3½	96	110	296750	118 00
400	500	2500	3	6500	3¾	105	120	296751	144 00
<b>Double-Throw</b>									
200	200	4500	2	3200	5½	118	135	296752	153 00
200	200	4500	3	3200	5½	131	150	296753	180 00
400	500	2500	2	6500	5½	127	145	296754	198 00
400	500	2500	3	6500	5½	139	160	296755	235 00
<b>Non-Automatic—Wall-Mounting*—Remote-Control</b>									
<b>Single-Throw</b>									
200	200	4500	2	3200	3¼	100	115	296756	109 00
200	200	4500	3	3200	3½	109	125	296757	130 00
400	500	2500	2	6500	3½	105	120	296758	143 00
400	500	2500	3	6500	3¾	113	130	296759	169 00
<b>Double-Throw</b>									
200	200	4500	2	3200	5½	135	155	296760	203 00
200	200	4500	3	3200	5½	148	170	296761	230 00
400	500	2500	2	6500	5½	144	165	296762	248 00
400	500	2500	3	6500	5½	157	180	296763	285 00

TABLE II—TYPE F-22 OIL CIRCUIT BREAKERS

Non-Automatic, Panel-Mounting, Direct-Control ¶

<b>On Panel 1½ or 2-Inches Thick</b>									
<b>Single-Throw</b>									
400	500	7500	1	1600	3	72	90	333407	\$ 81 00
400	500	7500	2	2500	7½	92	110	333408	128 00
400	500	7500	3	2500	7½	108	125	333409	157 00
400	500	7500	4	2500	10	150	175	333410	191 00
600	750	7500	1	1600	3	77	90	333411	90 00
600	750	7500	2	2500	7½	103	120	333412	143 00
600	750	7500	3	2500	7½	123	145	333413	183 00
600	750	7500	4	2500	10	173	200	333414	224 00
800	1000	2500	1	5700	2¾	72	90	333415	106 00
800	1000	2500	2	9000	6½	98	120	333416	181 00
800	1000	2500	3	9000	6½	115	130	333417	232 00
800	1000	2500	4	9000	9	173	200	333418	290 00
<b>Non-Automatic—Wall Mounting*—Remote-Control—Single-Throw</b>									
400	500	7500	1	1600	3	87	100	333419	106 00
400	500	7500	2	2500	7½	107	125	333420	153 00
400	500	7500	3	2500	7½	123	145	333421	182 00
400	500	7500	4	2500	10	165	190	333422	216 00
600	750	7500	1	1600	3	92	110	333423	115 00
600	750	7500	2	2500	7½	118	135	333424	168 00
600	750	7500	3	2500	7½	138	160	333425	208 00
600	750	7500	4	2500	10	188	215	333426	249 00
800	1000	2500	1	5700	2¾	87	100	333427	131 00
800	1000	2500	2	9000	6½	113	130	333428	206 00
800	1000	2500	3	9000	6½	130	150	333429	257 00
800	1000	2500	4	9000	9	188	215	333430	315 00

†It is recommended that the application of the breakers as panel-mounting breakers be limited to service not exceeding 2500 volts in accordance with "The Electric Power Club Oil Circuit-Breaker Standard Practice Rules." Where the service exceeds 2500 volts remote control apparatus is recommended.

\*Wall mounting breakers can be made pipe mounting by the addition of pipe mounting brackets. Pipe mounting brackets will be furnished "free of charge" with wall mounting breakers when included as an extra item with the wall mounting breakers for which they are intended.

†These breakers are non-automatic. For automatic operation add the necessary attachments shown on pages 217 to 221 inclusive.

†Weight does not include oil. Net weight of oil is approximately 7½ pounds per gallon; shipping weight of oil is approximately 9 pounds per gallon.

## TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

**TABLE III—F-22 MULTIPLE SINGLE-POLE OIL CIRCUIT-BREAKERS**  
**Non-Automatic—Remote Control—Wall Mounting\***  
**Single-Throw—Manually-Operated**

MAX. CONTINUOUS AMPERES		Maximum Volts	No. Poles	Interrupting Capacity in Amps. at Rated Volts	Gal. Oil	APPROX. WT., LBS. †		Style No.	List Price
60 Cycle	25 Cycle					Net	Ship.		
400	500	7500	2	2900	6	130	200	383369	\$225 00
400	500	7500	3	2900	9	190	270	383370	330 00
400	500	7500	4	2900	12	250	340	383371	440 00
600	750	7500	2	2900	6	140	210	383372	250 00
600	750	7500	3	2900	9	205	285	383373	375 00
600	750	7500	4	2900	12	270	360	383374	500 00
800	1000	2500	2	10400	5½	130	200	383375	275 00
800	1000	2500	3	10400	8½	190	270	383376	415 00
800	1000	2500	4	10400	11	250	340	383377	550 00

**TABLE IV—TYPE F-22 OIL CIRCUIT-BREAKERS**  
**Non-Automatic—Electrically-Operated—Wall Mounting\***  
**125-Volt Direct-Current Control**

400	500	7500	1	1600	3	142	202	383348	\$236 00
400	500	7500	2	2500	7½	162	232	383349	283 00
400	500	7500	3	2500	7½	180	260	383350	312 00
400	500	7500	4	2500	10	220	310	383351	348 00
600	750	7500	1	1600	3	147	207	383352	245 00
600	750	7500	2	2500	7½	173	243	383353	298 00
600	750	7500	3	2500	7½	193	273	383354	338 00
600	750	7500	4	2500	10	243	333	383355	379 00
800	1000	2500	1	5700	2½	142	202	383356	261 00
800	1000	2500	2	9000	6½	168	238	383357	336 00
800	1000	2500	3	9000	6½	185	265	383358	387 00
800	1000	2500	4	9000	10	243	333	383359	445 00

**TABLE V—TYPE F-22 MULTIPLE SINGLE-POLE OIL CIRCUIT-BREAKERS**  
**Non-Automatic—Electrically-Operated—Wall Mounting\***  
**125-Volt Direct-Current Control**

400	500	7500	2	2900	6	200	270	383360	\$365 00
400	500	7500	3	2900	9	260	380	383361	470 00
400	500	7500	4	2900	12	320	410	383362	580 00
600	750	7500	2	2900	6	210	270	383363	390 00
600	750	7500	3	2900	9	275	355	383364	515 00
600	750	7500	4	2900	12	340	430	383365	640 00
800	1000	2500	2	10400	5½	200	270	383366	415 00
800	1000	2500	3	10400	8½	260	340	383367	555 00
800	1000	2500	4	10400	11	320	410	383368	690 00

\*Wall mounting breakers can be made pipe mounting by the addition of pipe mounting brackets. Pipe mounting brackets will be furnished "free of charge" with wall mounting breakers when included as an extra item with the wall mounting breakers for which they are intended.

†Weight does not include oil. Net weight of oil is approximately 7½ pounds per gallon; shipping weight of oil is approximately 9 pounds per gallon.

**TABLE VI—AUXILIARIES FOR MANUALLY OPERATED TYPES F-11  
AND F-22 OIL CIRCUIT-BREAKERS**

Amperes	Style No.	List Price
<b>Series- or Transformer-Trip Coil Attachment Complete (Fig. 11)</b>		
5	296765	\$8 75
<b>Series-Trip Coil Attachment Complete, 750 Volts Max. (Fig. 11)</b>		
10	296766	19 80
25	296767	19 80
50	296768	19 80
75	296769	19 80
100	296770	19 80
150	296771	19 80
200	296772	19 80
<b>Series- or Transformer-Trip Coil with Inverse-Time-Limit Attachment Complete (Fig. 13)</b>		
5	296773	21 50

TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

AUXILIARIES FOR MANUALLY OPERATED TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

Amperes	Style No.	List Price
<b>Series-Trip Coil with Inverse-Time-Limit Attachment Complete (750 Volts Max.) (Fig. 13)</b>		
10	296774	\$32 75
25	296775	32 75
50	296776	32 75
75	296777	32 75
100	296778	32 75
150	296779	32 75
200	296780	32 75

5	296781	22 50
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Shunt-Trip Attachment Complete for Alternating-Current (Fig. 11)

25-Cycle				60-Cycle			
Volts	Resistance	Style No.	List Price	Volts	Resistance	Style No.	List Price
110	no	296784	\$9 90	100	no	296787	\$9 90
220	no	296785	9 90	220	no	296784	9 90
440 & 550	no	296786	9 90	440 & 550	no	296785	9 90

Shunt-Trip Attachment Complete for Direct-Current (Fig. 11)

Volts	Resistance	Style Number	List Price
125	no	296784	\$9 90
250	no	296785	9 90
500	no	296786	9 90

Hand-Retrieve Undervoltage-Release Attachment Complete (Fig. 18)†

Volts	25-Cycle		List Price	60-Cycle		List Price
	With Resistance	Without Resistance		With Resistance	Without Resistance	
110	315715	296792	\$30 50	315709	296791	\$30 50
177	315710		30 50	315710		30 50
220	315717	296793	30 50	315711	296792	30 50
360	315718		30 50	315712		30 50
440	315719	296794	30 50	315713	296793*	30 50
550	315720	296795	30 50	315714	296793*	30 50

\*The same coil is used in this case for 440 and 550 volts.

†For automatic-retrieve undervoltage-release attachment see section on "Oil Circuit-Breakers for Motor Starting."

Electric Lockout Device Complete (Fig. 19)

Volts	25-Cycle		List Price	60-Cycle		List Price
	Style No.	Style No.		Style No.	Style No.	
110	333055	333054	\$30 00	333054	333054	\$30 00
220	333056		30 00	333055		30 00
440	333057		30 00	333056		30 00
550	333058		30 00	333056		30 00

Miscellaneous Auxiliaries

Description	Breaker Amps.	Volts	Style No.	List Price
Mechanical Sequence Interlock (Figs. 21 & 22)	As described		333061	\$65 00
Mechanical Interlock for 2 handle coverplate (Fig. 19)	As described		333059	7 00
Mechanical Interlock for 2 single handle coverplates on 13½ inch centers	As described		333060	7 00
Common trip mechanism for two, 2 coil, single handle coverplates on 13½ inch centers (Fig. 24)	As described		333247	1 10
Panel-bracket for single-throw coverplate 2-coil (Fig. 26)	all	all	300796	10 80
Panel-bracket for double-throw coverplate 3-coil	all	all	300790	14 40
Pipe-Mounting brackets (2 required per breaker) (Fig. 25)	all	all	296764	3 00
Auxiliary switch (Fig. 27)	all	all	296797	6 55
Bell alarm switch (Fig. 23)	all	all	296798	3 30
Coverplate (only) 2-coil, single-throw	all	all	296782	14 00
**Coverplate (only) 3-coil, single-throw	all	all	296783	21 50
**Coverplate (only) 3-coil, double-throw	all	all	300642	28 75
Supporting framework for single-throw breaker or any coverplate (Fig. 28)	all	all	296799	34 00
Supporting framework for double-throw breaker (Fig. 28)	all	all	296800	34 00
1 set bell cranks (Fig. 7)	all	all	300695	25 25

\*\*Complete with handles but without tripping attachments.

TABLE VII—AUXILIARIES FOR TYPE F-22 ELECTRICALLY OPERATED OIL CIRCUIT-BREAKERS

Transformer Trip Attachment

Description	Style No.	List Price
5-ampere transformer overload trip coil attachment	363378	\$12 00
5-ampere transformer overload trip with inverse-time-limit attachment	363379	25 00
5-ampere transformer overload trip coil with direct trip attachment	363380	26 00

Undervoltage Release and Lockout Device

Volts	STYLE NUMBER		List Price
	25-cycle	60-cycle	
110	363382	363381	\$36 00
220	363383	363382	36 00
440	363384	363383	36 00
550	363385	363384	36 00

Shunt Trip Attachment

The 125-volt d-c. trip attachment, Style No. 296784, is supplied with each electrically operated breaker. For special applications this trip attachment may be replaced by any of those listed in Table VI for manually operated breakers, for either a-c. or d-c.

Miscellaneous

Hand closing lever for electrically operated breaker	Style No. 257123	List Price \$4 50
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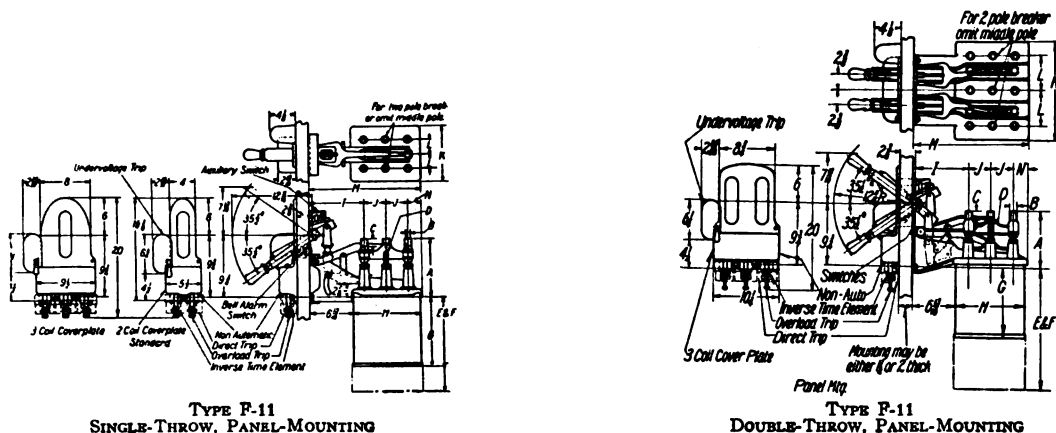
TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued

TABLE OF OUTLINE DIMENSIONS

Poles	Amperes	Volts	DIMENSIONS IN INCHES														
			A	B	C	D	E†	F‡	G	H	I	J	K	K‡	L	M	N
<b>Type F-11 Circuit-Breaker</b>																	
<b>Single-Throw</b>																	
2	200	4500	7 <sup>3</sup> / <sub>8</sub>	.558	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -13th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	8 <sup>3</sup> / <sub>4</sub>	.....	2 <sup>1</sup> / <sub>8</sub>	17 <sup>3</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>8</sub>
2	400	2500	8 <sup>5</sup> / <sub>8</sub>	.918	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	8 <sup>3</sup> / <sub>4</sub>	.....	2 <sup>1</sup> / <sub>8</sub>	17 <sup>3</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>8</sub>
3	200	4500	7 <sup>3</sup> / <sub>8</sub>	.558	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -13th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	8 <sup>3</sup> / <sub>4</sub>	.....	2 <sup>1</sup> / <sub>8</sub>	17 <sup>3</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>8</sub>
3	400	2500	8 <sup>5</sup> / <sub>8</sub>	.918	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	8 <sup>3</sup> / <sub>4</sub>	.....	2 <sup>1</sup> / <sub>8</sub>	17 <sup>3</sup> / <sub>4</sub>	2 <sup>1</sup> / <sub>8</sub>
<b>Double-Throw</b>																	
2	200	4500	7 <sup>3</sup> / <sub>8</sub>	.558	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -13th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	15 <sup>3</sup> / <sub>4</sub>	.....	5 <sup>1</sup> / <sub>2</sub>	18	2 <sup>1</sup> / <sub>8</sub>
2	400	2500	8 <sup>5</sup> / <sub>8</sub>	.918	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	15 <sup>3</sup> / <sub>4</sub>	.....	5 <sup>1</sup> / <sub>2</sub>	18	2 <sup>1</sup> / <sub>8</sub>
3	200	4500	7 <sup>3</sup> / <sub>8</sub>	.558	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -13th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	15 <sup>3</sup> / <sub>4</sub>	.....	5 <sup>1</sup> / <sub>2</sub>	18	2 <sup>1</sup> / <sub>8</sub>
3	400	2500	8 <sup>5</sup> / <sub>8</sub>	.918	1 <sup>1</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	18 <sup>5</sup> / <sub>8</sub>	21 <sup>7</sup> / <sub>8</sub>	10 <sup>7</sup> / <sub>8</sub>	10 <sup>3</sup> / <sub>4</sub>	8 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>2</sub>	15 <sup>3</sup> / <sub>4</sub>	.....	5 <sup>1</sup> / <sub>2</sub>	18	2 <sup>1</sup> / <sub>8</sub>
<b>Type F-22 Circuit-Breaker</b>																	
<b>Hand and Electrically Operated, Single-Throw, Common Frame and Multiple Single-Pole</b>																	
1	400	7500	9 <sup>1</sup> / <sub>8</sub>	.918	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	9 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	5	.....	.....	19 <sup>3</sup> / <sub>4</sub>	3
1	600	7500	11 <sup>1</sup> / <sub>8</sub>	1.28	1 <sup>3</sup> / <sub>8</sub>	1-14th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	9 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	5	.....	.....	19 <sup>3</sup> / <sub>4</sub>	3
1	800	2500	7 <sup>1</sup> / <sub>8</sub>	.875*	1 <sup>3</sup> / <sub>8</sub>	1-14th	19 <sup>1</sup> / <sub>2</sub>	23 <sup>3</sup> / <sub>8</sub>	11 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	9 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	5	.....	.....	19 <sup>3</sup> / <sub>4</sub>	3
2	400	7500	9 <sup>1</sup> / <sub>8</sub>	.918	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	12 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
2	600	7500	11 <sup>1</sup> / <sub>8</sub>	1.28	1 <sup>3</sup> / <sub>8</sub>	1-14th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	12 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
2	800	2500	7 <sup>1</sup> / <sub>8</sub>	.875*	1 <sup>3</sup> / <sub>8</sub>	1-14th	19 <sup>1</sup> / <sub>2</sub>	23 <sup>3</sup> / <sub>8</sub>	11 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	12 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
3	400	7500	9 <sup>1</sup> / <sub>8</sub>	.918	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	20 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
3	600	7500	11 <sup>1</sup> / <sub>8</sub>	1.28	1 <sup>3</sup> / <sub>8</sub>	1-14th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	12 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	20 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
3	800	2500	7 <sup>1</sup> / <sub>8</sub>	.875*	1 <sup>3</sup> / <sub>8</sub>	1-14th	19 <sup>1</sup> / <sub>2</sub>	23 <sup>3</sup> / <sub>8</sub>	11 <sup>3</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	20 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>8</sub>
4	400	7500	9 <sup>1</sup> / <sub>8</sub>	.918	1 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>2</sub> -16th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	27 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	23 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>
4	600	7500	11 <sup>1</sup> / <sub>8</sub>	1.28	1 <sup>3</sup> / <sub>8</sub>	1-14th	23 <sup>3</sup> / <sub>8</sub>	28	13 <sup>3</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	.....	3 <sup>1</sup> / <sub>2</sub>	23 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>
4	800	2500	7 <sup>1</sup> / <sub>8</sub>	.875*	1 <sup>3</sup> / <sub>8</sub>	1-14th	19 <sup>1</sup> / <sub>2</sub>	23 <sup>3</sup> / <sub>8</sub>	11 <sup>3</sup> / <sub>8</sub>	16 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>2</sub>	4	12 <sup>1</sup> / <sub>2</sub>	.....	3 <sup>1</sup> / <sub>2</sub>	23 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>

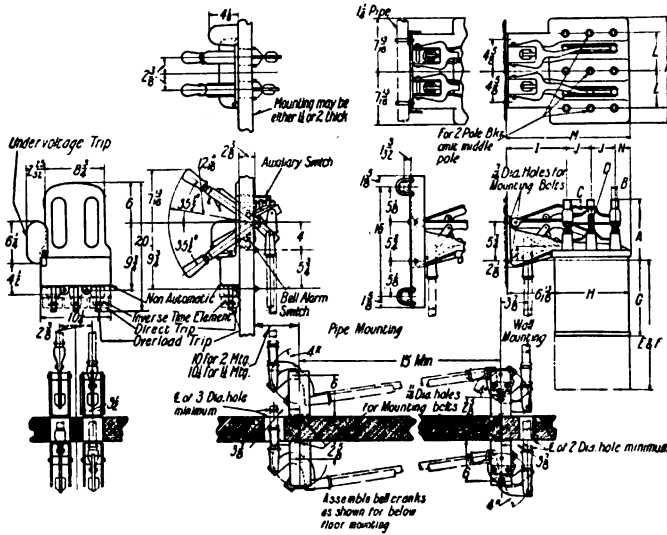
\*Two holes per terminal.  
 †Space required to remove tank with breaker closed.  
 ‡Space required to remove tank with breaker open.  
 §Multiple single-pole breaker.

OUTLINE DIMENSIONS IN INCHES

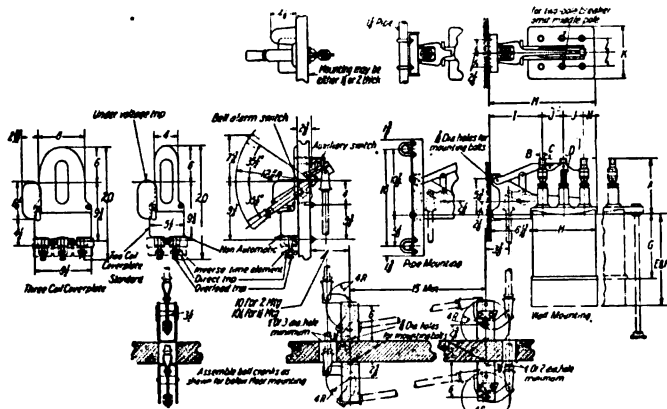


These dimensions are for reference only. For official dimensions apply to nearest district office.

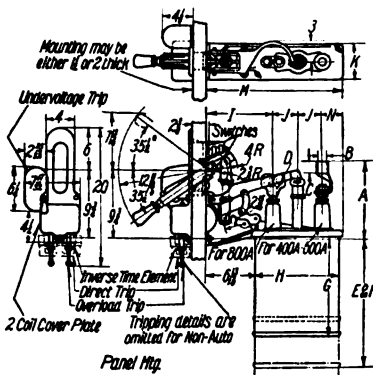
TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued



TYPE F-11, DOUBLE-THROW, REMOTE-CONTROL, WALL-MOUNTING



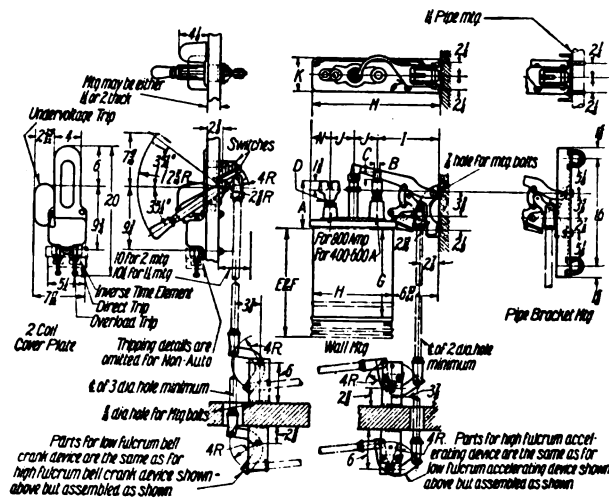
TYPE F-11, SINGLE-THROW, REMOTE-CONTROL, WALL-MOUNTING



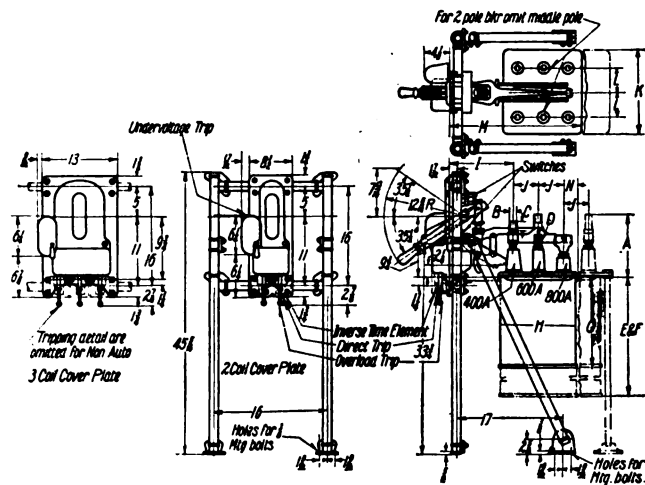
TYPE F-22—SINGLE-THROW, PANEL-MOUNTING

These dimensions are for reference only. For official dimensions apply to the nearest district office.

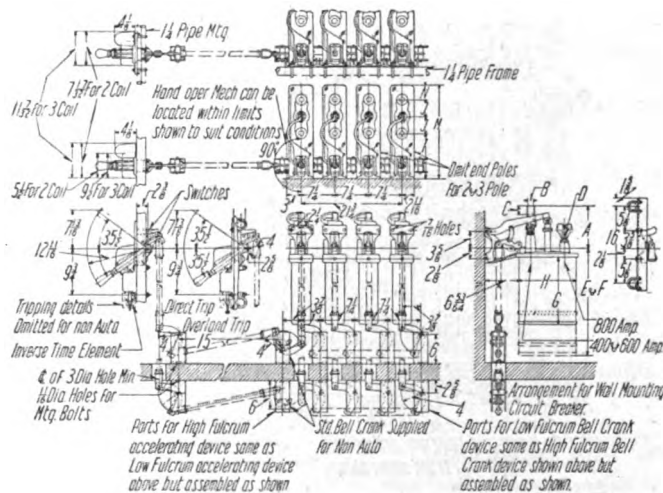
TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued



TYPE F-22, SINGLE-THROW, REMOTE-CONTROL, WALL OR PIPE-MOUNTING



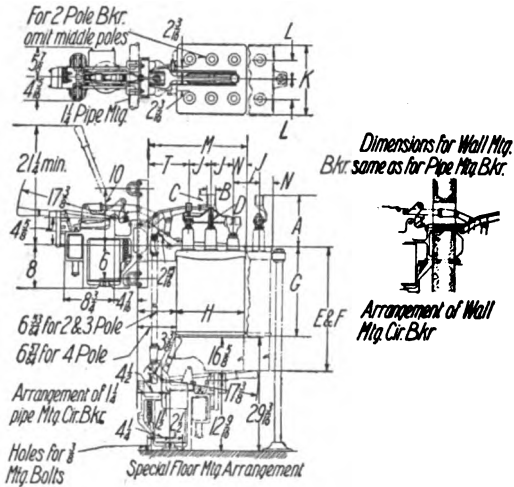
TYPE F-22, SINGLE-THROW PIPE-MOUNTING



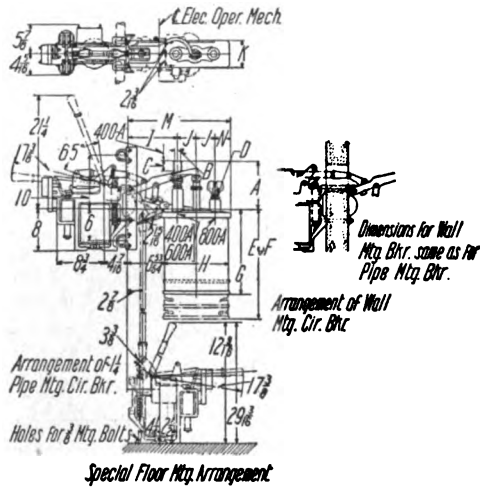
TYPE F-22 MULTIPLE SINGLE-POLE, REMOTE-CONTROL FOR WALL OR PIPE-MOUNTING

These dimensions are for reference only. For official dimensions apply to the nearest district office.

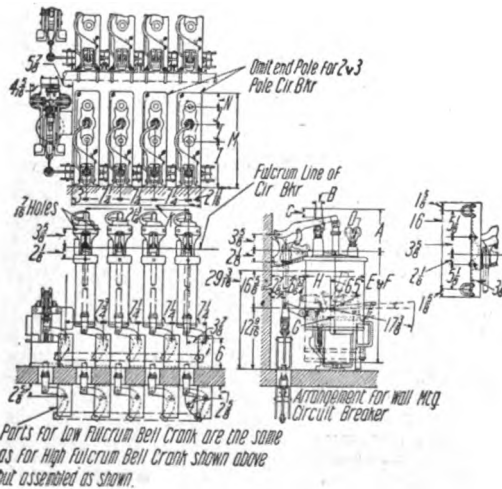
TYPES F-11 AND F-22 OIL CIRCUIT-BREAKERS—Continued



TYPE F-22 MULTIPOLE, ELECTRICALLY OPERATED FOR WALL OR PIPE-MOUNTING



TYPE F-22 SINGLE-POLE, ELECTRICALLY OPERATED FOR WALL OR PIPE-MOUNTING



TYPE F-22 MULTIPLE SINGLE-POLE, ELECTRICALLY OPERATED FOR WALL OR PIPE-MOUNTING

The dimensions are for reference only. For official dimensions apply to nearest office.

## TYPE F-33 OIL CIRCUIT-BREAKERS

Manually and Electrically Operated, Non-Automatic and Automatic,  
for Indoor Service, Single-Throw

For Capacities Up to 800 Amperes, 15,000 Volts Alternating Current

Interrupting Capacity at Rated Voltage, 1900 Amperes

Unless Otherwise Stated Ratings are on 60-cycle Basis

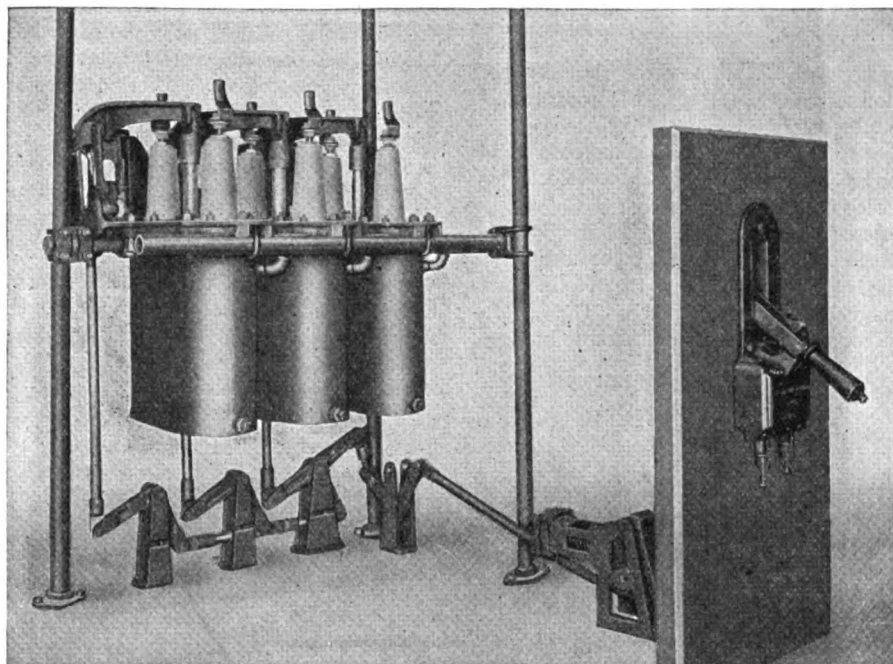


FIG. 1—TYPE F-33 MANUALLY-OPERATED CIRCUIT-BREAKER

### Application

See also pages on "Application of Oil Circuit-Breakers."

The type F-33 oil circuit-breaker is made in the remote-control form only. This practice conforms to the recommendations of the Electric Power Club's "Circuit-Breaker Standard Practice Rules," which limits the service of panel mounting breakers to voltages not exceeding 2500.

### Distinctive Features

Among the features which distinguish the type F-33 oil circuit-breakers are the following:

A highly efficient form of wedge and finger contact with auxiliary arcing contact on the moving element. The stationary contact is shaped and located so that different portions of the same contact surface act as the main current-carrying contact and as the arcing contact thus preventing arcing on the main contact surface.

Flared wedge contacts under heavy pressure.

Renewable arcing contacts on the moving element.

Submersion and opening of all contacts under oil.

Quick opening of contacts assisted by heavy auxiliary springs.

Open position of breaker maintained by gravity.

Strong elliptical, lap-welded, steel tanks.

Tanks not electrically alive.

Tanks removable without disturbing operating mechanism or contacts thus making inspection easy.

Individual tanks enclose contacts on each pole of the breaker.

Ample air space at tank top to allow for proper gas expansion.

Insulating linings in tanks.

It is impossible to hold full-automatic breakers in closed position against predetermined condition of tripping.

Unit type of pole construction.

Unit type of electrically operated mechanism having closing, tripping and accelerating features self-contained.

Either pipe or wall mounting without additional auxiliary brackets.

### Operation and Construction

The type F-33 breaker is supplied for either manual operation, automatic or non-automatic, or for non-automatic electrical operation.

## TYPE F-33 OIL CIRCUIT-BREAKERS—Continued

Automatic electrically operated breakers are obtained by the use of transformers and relays.

The breakers are furnished either single, two, three, or four-pole as standard.

Each pole of the breaker is a separate unit with its own frame, mechanism and tank. The heavy cast-iron framework is arranged for either wall, pipe, or any vertical flat surface mounting. The mechanism of the breaker is provided with a toggle which permits the breaker to be readily adapted for upward, downward or horizontal pull without the use of any additional material.

The breaker contacts follow the same type of construction as used in the type F-22 oil breakers which are fully described on preceding pages.

The sheet steel tanks are of Westinghouse standard construction with all seams lap-welded. They are lined with micarta.

The same coverplates, signal switches, trip coils, under-voltage attachments, direct trip attachments, etc., are used as are now used with the Westinghouse type B manually operated breakers. The calibration range for transformer trip automatic breakers

is from 80 per cent to 60 per cent of the normal full-load current (primary) rating of the current transformer in the trip coil circuit.

The electric operating mechanism has a three inch diameter core and is the one now used upon a number of our types BA and B-2 breakers except that the mechanism is mounted on the floor beneath and at the side of the breaker as shown in Fig. 2. This mechanism consists of a cast iron frame with spaces for closing and trip coils. The moving core of the closing solenoid pulls the main lever down to the closed position where it is latched. The trip coil disengages the latch. The mechanism is provided with springs to hasten the opening of the breaker. A two-pole double-throw auxiliary switch is used for cutting out trip coil currents and controlling indicating lamps. This mechanism may be provided with 5-ampere overload trip or under-voltage release on special order.

**Style number and list price** include the type F-33 breaker complete as described, with oil. See "Instructions for Ordering Oil Circuit-Breakers."

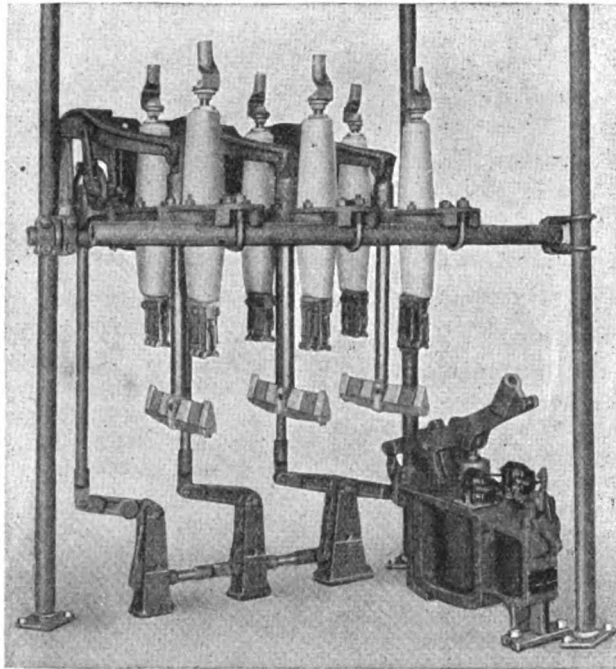


FIG. 2—TYPE F-33 ELECTRICALLY OPERATED CIRCUIT-BREAKER WITH TANKS REMOVED

## TYPE F-33 OIL CIRCUIT-BREAKERS—Continued

## PRICES

## Type F-33 Single-Throw, Wall and Pipe Mounting, Oil Circuit-Breakers†

MAXIMUM CONTINUOUS AMPERES		Maximum Volts	No. of Poles	Inter-rupting Capacity in Amps. at Rated Volts*	Gal. Oil	APPROXIMATE† Wt. POUNDS.		Style No. Complete Breaker	List Price
60-Cycle	25-Cycle					Net	Ship.		
<b>Manually Operated</b>									
400	500	15000	1	830	6 1/4	200	350	357114	\$285 00
400	500	15000	2	1900	12 1/2	370	600	332873	360 00
400	500	15000	3	1900	18 3/4	520	770	332874	440 00
400	500	15000	4	1900	25	665	935	332875	530 00
600	750	15000	1	830	6 1/4	205	355	357115	318 00
600	750	15000	2	1900	12 1/2	380	610	332876	403 00
600	750	15000	3	1900	18 3/4	535	805	332877	490 00
600	750	15000	4	1900	25	685	957	332878	590 00
800	1000	15000	1	830	6 1/4	210	360	357116	373 00
800	1000	15000	2	1900	12 1/2	390	620	332879	473 00
800	1000	15000	3	1900	18 3/4	550	820	332880	575 00
800	1000	15000	4	1900	25	705	1022	332881	690 00
<b>Manually Operated</b>									
400	500	15000	1	830	6 1/4	210	360	357117	295 00
400	500	15000	2	1900	12 1/2	385	615	332882	378 00
400	500	15000	3	1900	18 3/4	535	805	332883	458 00
400	500	15000	4	1900	25	680	952	332884	550 00
600	750	15000	1	830	6 1/4	215	365	357118	325 00
600	750	15000	2	1900	12 1/2	395	625	332885	420 00
600	750	15000	3	1900	18 3/4	550	820	332886	505 00
600	750	15000	4	1900	25	700	972	332887	610 00
800	1000	15000	1	830	6 1/4	220	370	357119	380 00
800	1000	15000	2	1900	12 1/2	405	635	332888	490 00
800	1000	15000	3	1900	18 3/4	565	815	332889	595 00
800	1000	15000	4	1900	25	720	992	332890	700 00
<b>Electrically Operated—Non-Automatic—125-Volt Direct-Current Control</b>									
400	500	15000	1	830	6 1/4	280	425	357120	450 00
400	500	15000	2	1900	12 1/2	565	795	332909	515 00
400	500	15000	3	1900	18 3/4	630	880	332910	575 00
400	500	15000	4	1900	25	775	1047	332911	680 00
600	750	15000	1	830	6 1/4	285	430	357121	485 00
600	750	15000	2	1900	12 1/2	575	805	332912	550 00
600	750	15000	3	1900	18 3/4	645	895	332913	620 00
600	750	15000	4	1900	25	795	1067	332914	735 00
800	1000	15000	1	830	6 1/4	290	435	357122	555 00
800	1000	15000	2	1900	12 1/2	585	815	332915	630 00
800	1000	15000	3	1900	18 3/4	645	895	332916	710 00
800	1000	15000	4	1900	25	795	1067	332917	840 00

\*For interrupting capacity of these breakers refer to data in general section and also data under "Application of Oil Circuit Breakers."

†Weight does not include oil. Net weight of oil is approximately 7 1/2 pounds per gallon; shipping weight, 9 pounds per gallon.

Order by Style Number





TYPE F-33 OIL CIRCUIT-BREAKERS—Continued

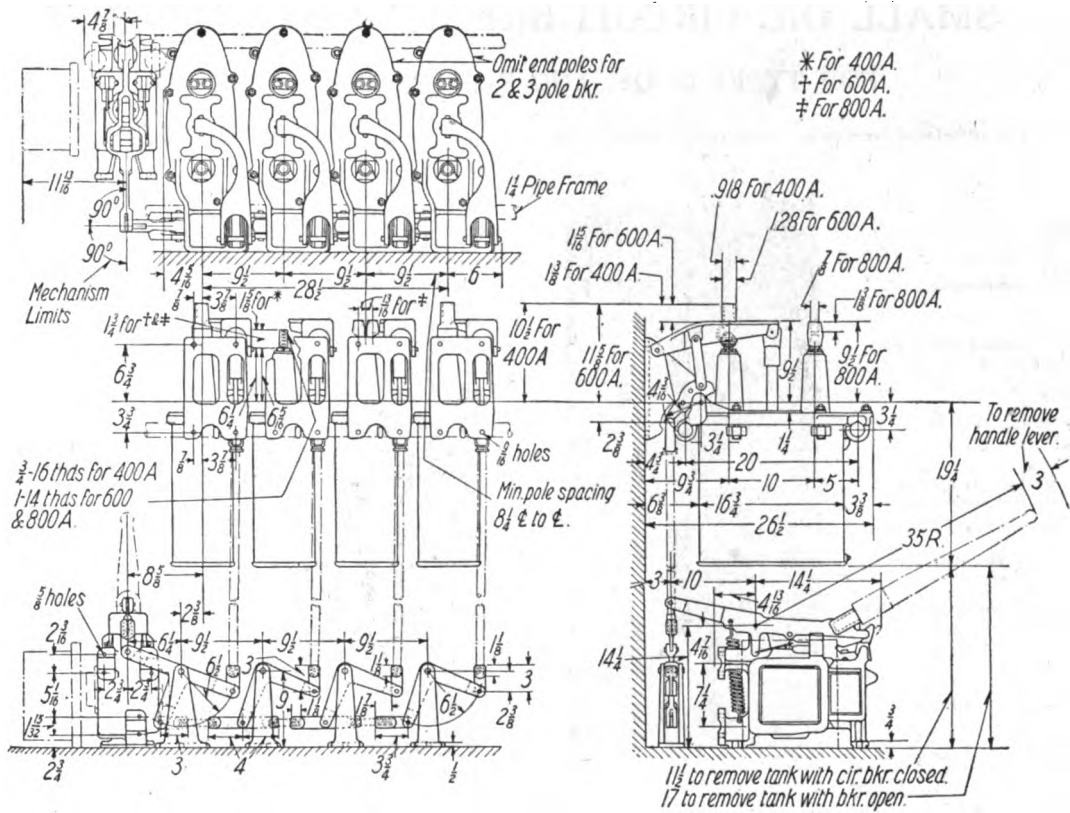


FIG. 5—TYPE F-33 ELECTRICALLY OPERATED MULTIPLE SINGLE-POLE OIL CIRCUIT-BREAKER

These dimensions are for reference only. For official dimensions apply to nearest district office.

## SMALL OIL CIRCUIT-BREAKER ACCESSORIES

### FOR TYPES D, QF, AND F-33 INDOOR BREAKERS

For additional accessories—terminals, control relays, controllers—see Section 2-B on "Switchboard Accessories"

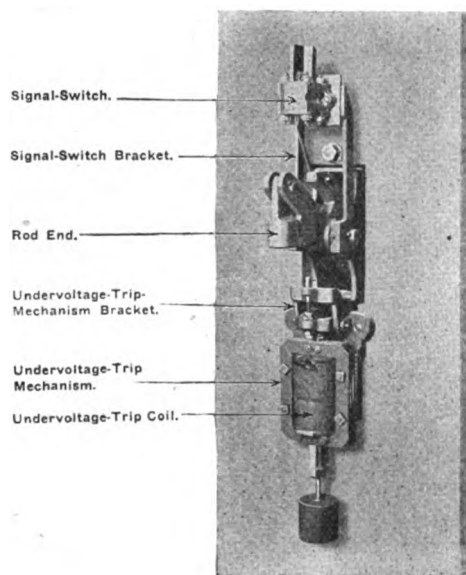


FIG. 1—REAR OF LONG-THROW COVERPLATE FOR SINGLE-THROW VERTICAL-PULL BREAKER, SHOWING ACCESSORIES INSTALLED

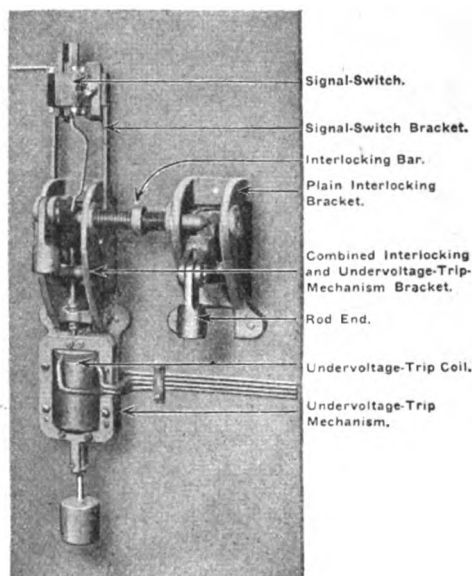


FIG. 2—REAR OF SINGLE-HANDLE COVERPLATE OF TWO INTERLOCKED BREAKERS—SHOWING ARRANGEMENT OF INTERLOCKING, ALSO SHOWING ACCESSORIES INSTALLED ON ONE COVERPLATE

On the following pages are listed attachments and auxiliaries adapted particularly for use with Westinghouse types D, QF, and F-33 oil circuit-breakers. In some cases one or more of these are included with the standard circuit-breaker as noted and listed on pages on the various types of oil circuit-breakers; in general these accessories should be ordered as separate items—in all cases they should be ordered at the same time that the breaker is ordered; they will then be shipped mounted on the breaker. Their application to any particular breaker can be determined definitely only by reference to the Company.

One or more of the oil circuit-breaker tripping accessories listed can be used without or in combination with the current overload trip coils mounted on the operating-handle coverplate as stated for the various types of oil circuit-breakers.

The coils in the accessories listed will carry their full-rated current continuously with a temperature rise not to exceed 50 degrees Centigrade above the surrounding atmosphere; corrections to be made as specified by A. I. E. E. rules when the temperature of the surrounding atmosphere is other than 25 degrees Centigrade.

Approximate weights and dimensions (where not shown) will be furnished on request. In general, the weight of the accessory will not materially affect the shipping weight of any breaker.

Current and voltage transformers and relays are described and listed in catalogue 3-B on "Instruments and Relays," and control relays, on another page of this section.

For diagrams of typical connections of circuit-breakers and circuit-breaker accessories, see pages on "Oil Circuit-Breakers,—General Information" and "Switchboard Data Book."

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

TRIP-MAGNET FRAMES

These laminated trip-magnet frames are for mounting the trip coils specified to the breaker mechanism. Each includes the bracket (frame proper), the trip mechanism, and the magnetic circuit complete for one coil—but does not include the coil (for which see following tables).

**Alternating-Current Underload-Trip Attachment**—The underload-trip attachment listed (made up of an underload trip-magnet frame and underload-trip coil) trips the breaker at approximately 50 per cent of normal load or less. Five-ampere trip coils should be used with 5-ampere-secondary current transformers; these coils are connected in the circuit the same as the overload coils (see diagrams of connections under "Oil Circuit-Breakers—General Information.")

**Undervoltage-Trip Attachment**—The standard undervoltage-trip attachment (made up of undervoltage trip-magnet frame and undervoltage-trip coil) trips the breaker at approximately 50 per cent of normal voltage or less.

With types F-11 and F-22 motor-starting equipments, it is necessary to use an automatic-reset undervoltage release. Prices and description will be furnished on request.

**Style number includes frame complete without coil.** List price includes mechanism complete with trip coil which must be specified from tables on this and the following pages.

**Trip-Magnet Frames for Alternating-Current Underload or Undervoltage-Trip Mechanisms on Manually-Operated Type F-33 Oil Circuit-Breakers**

Operation of Reset	Description	FOR BREAKER		Number Poles	Style No.	List Price
		Type				
Automatic†	{ Single-throw remote-control without bracket } { for interlocking bar }	F-33		1, 2, 3, 4	214082	\$36 25

†Hand reset can be supplied on special order.

**Trip-Magnet Frames for Alternating-Current Overload, Shunt, Overvoltage-Trip or Undervoltage-Trip on Electrically-Operated Type F-33 Oil Circuit-Breakers**

Trip	FOR BREAKER		Style No.	List Price
	Type	Number Poles		
{ Overload } { Shunt, or } { Overvoltage }	F-33	2, 3, 4	150614	\$32 00
Undervoltage	F-33	2, 3, 4	287131	40 00

TRIP COILS

These coils are for mounting in the proper trip-magnet frames listed above for obtaining on types QF and F-33 manually-operated or type F-33 electrically operated oil circuit-breakers the method of trip designated. Some of these coils can be

mounted on the standard automatic-overload coverplate of the types QF and F-33 breakers. The coils must be ordered separately.

**Style number and list price include complete coil but do not include frame or coverplate.**

Note—Frame list prices in the previous tables include the necessary trip coil

**Trip Coils for Overload, Underload, and Undervoltage Trip**

Trip	Volts	Amperes	25-CYCLE		60-CYCLE	
			Style No.	List Price	Style No.	List Price
{ Overload } { or } { Underload }	...	5	224185	\$6 50	224185	\$6 50
Undervoltage	{ 110	.....	148909	.....	148908	.....
	{ 220	.....	148907	.....	148909	.....
	{ 440	.....	165220	.....	148907	.....
	{ 550	.....	201482	.....	241504	.....

**Trip Coils for Shunt Trip**

Nominal Volts	STANDARD OPERATING RANGE		FOR DIRECT-CURRENT CIRCUITS		FOR ALTERNATING-CURRENT CIRCUITS			
	Minimum Volts	Maximum Volts	Style No.	List Price	25-CYCLE		60-CYCLE	
					Style No.	List Price	Style No.	List Price
110	60	125	256857	\$ 8 75	148908	\$6 50	256859	\$8 35
220	120	250	201482	12 50	148909	5 90	148908	6 50
440	240	500	256858	9 55	148907	7 90	148906	5 40
550	360	630	201397	11 00	241504	8 65	148909	5 90

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

Trip Coils for Overvoltage Trip

The overvoltage coils listed are calibrated (coils cold) between the standard calibration range shown. An error of approximately 20 per cent maximum is possible within the permissible temperature rise.

The scales on the overvoltage trip magnets can be marked to compensate for any given working temperature on special order; price on request.

Nominal Volts	STANDARD CALIBRATION RANGE		FOR ALTERNATING-CURRENT CIRCUITS ONLY			
	Minimum Volts	Maximum Volts	25-CYCLE		60-CYCLE	
			Style No.	List Price	Style No.	List Price
110	110	220	148909	\$ 5 90	148908	\$6 50
220	220	440	148907	7 90	148909	5 90
440	440	880	165220	8 55	148907	7 90
550	550	1100	201482	12 60	241504	8 65

INVERSE-TIME-LIMIT ATTACHMENTS

Adjustable inverse-time-limit attachments are listed for direct mounting on the current trip magnets of the overload-trip coverplates and electric-operating-mechanism of type F-33 automatic oil circuit-breakers.

The use of the inverse-time-limit attachment does away with the necessity for relays where an inverse-time-limit characteristic on the overload feature is desired.

The attachments for use on coverplates of manually-operated breakers are of the disc-type and are adjustable by varying the area of the moving disc that is directly opposed to the stationary disc. On 100 per cent overload a time-element of approximately 5 seconds is obtainable, and by adjustment this may be varied downwards to 0. A longer time-element may be obtained up to approximately 10 seconds by using a heavier oil than that provided with the attachment; but the heavier oils are affected to a much greater extent by differences of temperature than the standard oil furnished, and do not allow of as quick resetting of the discs. Instructions for mixing heavier oil and for adjustment are furnished with the attachment.

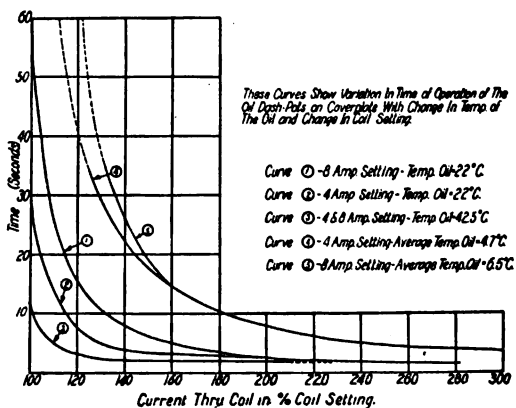


FIG. 3—TIME ELEMENT OF DASHPOTS

The attachment for use on electrically-operated breakers is on the plunger type. The time adjustment on this form is made by varying the opening of the valve discs on the plunger. For mounting this attachment on electrically-operated breakers having floor-mounted operating-magnet mechanisms, it will be necessary with some breakers to mount the mechanism higher than its normal position on the floor.

Style number and list price include attachment complete for use with an alternating-current overload coil of either panel-mounting or manual or electric remote-control type F oil circuit-breakers.

Style No.	Description	List Price
214143	For manually-operated breaker	\$13 00
256852	For electrically-operated breaker	34 75
229296	1/2 pint of dashpot oil	25

DIRECT-TRIP ATTACHMENTS

Conditions are often found where a reliable source of direct-current or alternating-current is not available for operating the shunt-trip coils of alternating-current breakers through contact-closing relays; for this purpose the direct-trip attachment is provided. This attachment consists of a retaining magnet mounted on the alternating-current trip magnets of the switchboard coverplate or the electrical operating mechanism of an automatic breaker. It operates to prevent the

tripping plunger from acting to trip the breaker until the circuit-closing relay operates to cut out the attachment magnet. It requires no separate power circuit and is applicable with circuit-closing relays in place of series-trip relays of the circuit-opening type. It is operated from the same current transformers as operate the relays and the breaker trip coils, and may be used with either overload relays or reverse-power relays.

Order by Style Number

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

The transformers which may or may not be used are as follows:

Current transformers, types A, KR and FR, all capacities; types FS and FB under 1600 amperes primary capacity; and all bushing-type transformers operating from circuit-breaker terminals, should not be used in connection with the direct-trip attachment.



FIG. 4—DIRECT-TRIP ATTACHMENT APPLIED ON SINGLE-HANDLE TWO-COIL COVERPLATE

Current transformers, types FS and FB of 1600 amperes primary capacity and above, and all capacity transformers, types KA, KB, KC, OA, OB and OC, may be used to operate the direct-trip attachment, and will provide for accurate operation of the types CO or CR relays, and an ammeter in connection therewith.

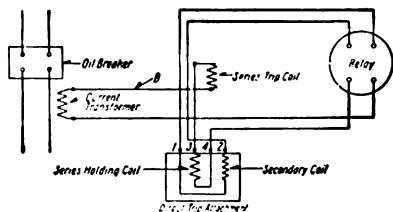


FIG. 5—SCHEMATIC DIAGRAM OF CONNECTIONS FOR SINGLE-PHASE CIRCUITS

It is recommended that the device be ordered with the breaker or coverplate upon which it is to be used. When there is any doubt as to the feasibility of a particular application of this attachment under any conditions whatever, it is preferable to submit the proposition to the Company for a recommendation.

Where reliable shunt tripping can be obtained, this will generally be considered preferable to the direct-trip attachment, but the direct-trip attachment will generally be more satisfactory than any form of series-trip relay so far placed on the market.

List price includes the direct-trip attachment applied to standard Westinghouse Type F-33 circuit-breaker coverplates or sold separately from breaker. One attachment with or without shunt is required for each current trip coil.

Style No.	Description	List Price
304494	Direct-Trip Attachment	\$14 00

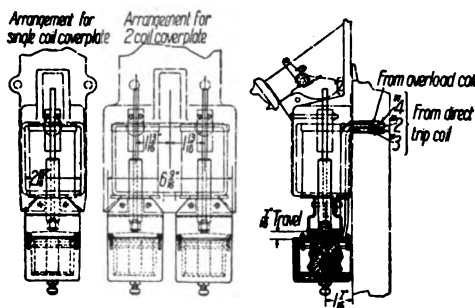


FIG. 6—APPROXIMATE DIMENSIONS

SIGNAL AND SHUNT-TRIP CUT-OUT SWITCHES

These are double-pole double-throw switches used for controlling the signal-lamp circuit, and for electrically interlocking or tripping other circuit-breaker apparatus. The standard switches are for mounting on the rear of the remote-control single or double-handle coverplate of the remote-control oil breakers or on the frame of the panel-mounting breakers.

While insulated for 250 volts and capable of conducting 15 amperes, these switches will not open the circuit with more than 5 amperes at 250 volts or 10 amperes at 125 volts.

Style number and list price include switch, bracket, connecting link, and bolts complete for mounting—one switch is required per handle.

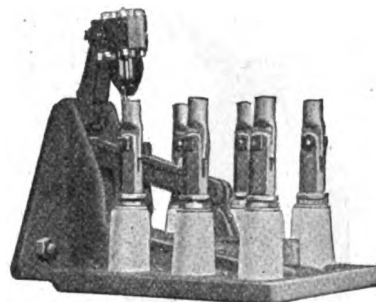


FIG. 7—SIGNAL SWITCH COMPLETE WITH BRACKET MOUNTED ON TOP OF PANEL-MOUNTING BREAKER

FOR MOUNTING ON COVERPLATE OF BREAKER		Type	Number Poles	Throw	Style No.	List Price
PANEL MOUNTING } REMOTE CONTROL }	QF	F-33 QF	4	Double	240475	\$11 90
			1, 2, 3, 4	Single Double	214857 214856	10 00 10 00

Order by Style Number

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

BELL-ALARM SIGNAL-CONTACT ATTACHMENTS

Bell-alarm signal-contact attachments are used for closing a low-voltage signal circuit when the breaker trips automatically (the breaker can be tripped by hand without actuating this attachment).

This attachment can be mounted directly on all the automatic-overload trip coverplates of the manually-operated panel-mounting or remote-control oil circuit-breakers.

Style number and list price include device complete for either panel-mounting or remote-control type QF or remote-control type F-33 oil circuit-breakers.



FIG. 8—BELL-ALARM SIGNAL-CONTACT ATTACHMENT ON REAR OF COVERPLATE OF SINGLE-THROW HORIZONTAL-PULL BREAKER

Style No.	List Price
214192	\$10 80

MICARTA TERMINAL-INSULATING TUBES

It is recommended on the pages on the various types of oil circuit-breakers that all terminals be insulated (after installation) on breakers used on circuits of 2200 volts and higher. This can be done most easily and satisfactorily by slipping over the terminal and lead one moisture-proof Micarta tube per terminal, such tubes being made especially for this purpose. These tubes are not closed at the end so that a cap at the top (made by taping or

otherwise) should preferably be added to keep out dirt. Wood caps, for use with any tube listed, can be supplied on special order for any given cable diameters; prices on request.

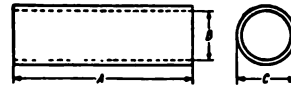


FIG. 9—APPROXIMATE DIMENSIONS

Type	BREAKER		APPROXIMATE DIMENSIONS, INCHES			Style No.	List Price
	Amps.	Volts	A	B	C		
D	300	7500	10	2 3/4	2 3/4	199124	\$1 50
F-33	400-600-800	15000	12 3/4	1 7/8	2 1/2	211846	1 80

SPECIAL MOUNTING BRACKETS

Separate Wall-Mounting Brackets



FIG. 10—WALL-MOUNTING BRACKET SUPPORT

For mounting standard panel-mounting breakers with remote-control coverplate directly on the wall. In the case of the type D oil breaker only the breaker may be mounted with direct-control handle.

Style number and list price include bracket complete with U-bolts or mounting bolts.

Type	Throw	Poles	FOR REMOTE-CONTROL BREAKER		BRACKET		Style No.	List Price
			Amps.	Volts	Number Required Per Breaker			
D	Single	2, 3, 4	200	4500	1	219947	\$ 9 55	
			300	1500	1	219948	9 55	
			300	7500	1	219943	10 00	
D	Double	2, 3, 4	200	4500	1	219955	9 75	
			300	1500	1	219956	10 00	
			300	7500	1	219943	10 00	

Order by Style Number

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

Separate Pipe-Mounting Brackets

For Remote-Control Manually-Operated Breakers

For mounting standard panel-mounting breakers with remote-control coverplate directly on two parallel pipes, horizontally mounted, one 16 inches above the other. These parallel pipes (1¼-inch standard pipe size) are to be supplied by the user and may be supported in any manner desirable (by pipe or angle-iron frame work properly braced) as no other support is required for the breaker, except in some cases the addition of the rear pipe support for breaker as is required in other methods of mounting.

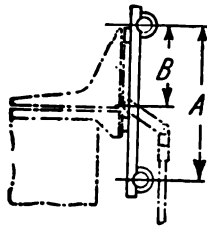


FIG. 11

This style of mounting provides a means of support accessible from all sides, and makes unnecessary mounting the apparatus on the station wall.

Style number and list price include bracket complete with U-bolts for 1¼-inch pipe stringers.

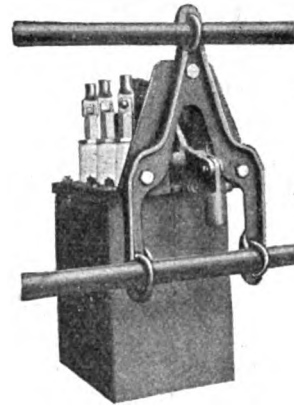


FIG. 12—PIPE-MOUNTING BRACKET SUPPORT

Type	Number Poles	FOR BREAKER			APPROXIMATE DIMENSIONS, INCHES		BRACKET		List Price
		Throw	Amps.	Volts	A	B	Style No.	Number Required Per Breaker	
D	.....	Single	100-200	.....	16	7½	127520	1	\$6 85
D	.....	Double	100-200	.....	16	7½	127520	1	6 85
D	2, 3, 4	Single	200	4500	16	...	219945	1	7 70
D	2, 3, 4	Double	200	4500	16	...	219945	1	7 70
D	2, 3, 4	Single	300	1500	16	7½	219946	1	6 85
D	2, 3, 4	Double	300	1500	16	8½	219946	1	6 85
D	2, 3, 4	Single	300	7500	16	...	219944	1	6 85
D	2, 3, 4	Double	300	7500	16	...	219944	1	6 85
D	.....	Single	300	7500	16	4½	187785	1	6 10
D	.....	Double	300	7500	16	6½	187785	1	6 10

Separate Pipe-Mounting Brackets

For Direct Manually-Operated Breakers

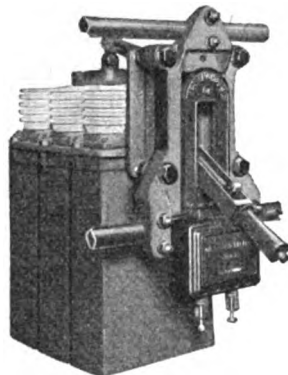


FIG. 13—PIPE-MOUNTING BRACKET SUPPORTING PANEL-MOUNTING BREAKER AND COVERPLATE

For mounting the standard panel-mounting breakers with coverplate directly on two parallel pipes, horizontally mounted 16 inches center to center.

Style number and list price include bracket complete with U-bolts for 1¼-inch pipe stringers.

FOR PANEL-MOUNTING BREAKER		BRACKET		List Price
Type	Poles	Style No.	Number Required Per Breaker	
F-33	1, 2, 3, 4	215187	1	\$14 00

Mounting Bolts

Style number and list price include finished bolt with nut for mounting breakers direct on special mounting brackets or panels.

Type	FOR USE WITH OIL CIRCUIT-BREAKERS Poles	Amps.	Volts	Style No.	Number Required Per Breaker	List Price
D	2, 3, 4	200	4500	219154	3	\$0 45
D	2, 3, 4	300	1500-7500	219153	3	45

SMALL OIL CIRCUIT-BREAKER ACCESSORIES—Continued

REMOTE-CONTROL COVERPLATES

Style number and list price include coverplate complete with mounting bolts handles and with overload-trip coils on automatic coverplates.

FOR USE WITH OIL CIRCUIT-BREAKERS	Throw	Poles	Number 5-Ampere Trip Coils Required Per Coverplate	FOR AUTOMATIC CIRCUIT-BREAKERS		FOR NON-AUTOMATIC CIRCUIT-BREAKERS	
				Style No.	List Price	Style No.	List Price
D	{ Single	2, 3, 4	..	.....	.....	216063	\$5 00
	{ Double	2, 3, 4	..	.....	.....	216064	5 65
F-33	{ Single	2	1	208917	\$13 25	233249	6 25
	{ Single	3, 4	2	208918	17 00	233249	6 25

THE SEQUENCE INTERLOCK

The mechanical sequence interlock is for use with the type QF motor starting circuit-breaker and breaker combinations used to start, in connection with auto transformers, three phase squirrel cage induction motors and self-starting synchronous motors. It is also applicable with Type F-33 Breakers. It provides the proper sequence of operations making it impossible to throw full voltage on a motor without first applying the starting voltage. Second, it makes it impossible to short-circuit the auto transformers in that it requires a complete opening of the starting side of a circuit-breaker before the running side can be started to the closed position.

Style numbers include all material necessary to mount sequence interlock on cover plate.

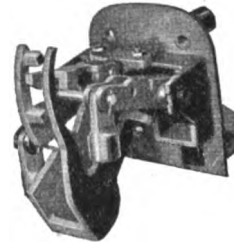


FIG. 14—SEQUENCE INTERLOCK

Breaker	Description	Style No.	List Price Each
Type QF	Panel Mounting	302181	\$18 00
Type QF	Remote Control	302180	22 00
Type F-33	Remote Control	357167	25 00

MECHANICAL INTERLOCKING ATTACHMENTS

For interlocking a pair of breakers of the same type, mounted in the same plane and on given center, these mechanical interlocking devices are to prevent both breakers being closed at the same time. Special mechanical interlocks can be supplied on special order for interlocking pairs of breakers of different types and for interlocking three or more breakers of the same or different types. In fact, there is practically no limit to the amount of interlocking possible on special order. Send your problems to the nearest district office of the Company for complete information.

Style number and list price include mechanism complete.

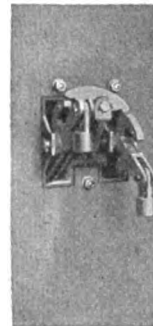


FIG. 15—REAR OF DOUBLE-HANDLE COVERPLATE, SHOWING INTERLOCKING ATTACHMENT

Type	Mounting	Throw	FOR BREAKER		Distance Between Centers of Breakers Inches	Description	Style No.	List Price
			With Complete					
F-33	Remote	Single	1 or 2 Coil		8	Interlock Complete	214593	\$10 00
F-33	Remote	Single	3 Coil		9 1/2	Interlock Complete	214855	10 00
F-33	Remote	Double	{ Double-Handle with Undervoltage Coil	}	9 1/2	Interlock Complete	241449	2 25
F-33	Remote	Double	{ Double-Handle without Undervoltage Coil					
F-33	Remote	Single	1, 2, or 3 Coil		11	Interlock Complete	241453	13 40
F-33	Remote	Double	{ Between Handles on Double-Coil Coverplate	}	....	Interlock Complete	214863	3 45

HAND-CLOSING HANDLES

Hand-closing handles are listed for closing the electrically-operated breakers of different types and size in case of failure of the operating current. Style number and list price include handle complete.

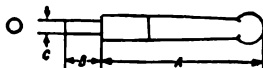


FIG. 16

For Breaker, Type	Fig.	DIMENSIONS, INCHES			Style No.	List Price
		A	B	C		
F-33	14	24	4	3/4	229280	\$10 80

NOTE—These dimensions are for reference only. For official dimensions, apply to the nearest district office.

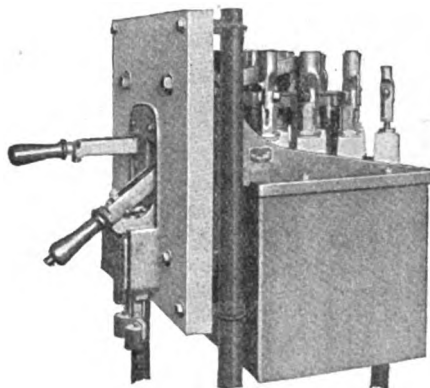


## OIL CIRCUIT-BREAKERS FOR MOTOR STARTING

### MANUALLY-OPERATED—FOR INDOOR SERVICE

### NON-AUTOMATIC STARTING POSITION—AUTOMATIC RUNNING POSITION

For Capacities up to 800 Amperes 4500 Volts A-C.  
Interrupting Capacities of 1000 to 3000 Amperes at Service Voltage



TYPE QF AUTO-STARTER, STARTING HANDLE IN OFF POSITION, RUNNING HANDLE IN CLOSED POSITION

### APPLICATION

Motor-starting oil circuit-breakers are especially designed for starting, in connection with auto-transformers, three-phase squirrel-cage induction and self-starting synchronous motors. When properly applied they protect the motor in the running position from heavy overloads and short circuits, and guard it against the sudden application of full voltage to the motor after it has slowed down or come to rest following an interruption of power supply.

For proper application to motors see Table I on following pages.

The breakers listed herein are suitable for motors having the same starting characteristics as standard Westinghouse motors. When starting equipments for motors of other than Westinghouse manufacture are desired, full motor data as indicated under

"Instructions for Ordering" should be referred to the nearest district office of the Company.

When the system capacity is higher than the interrupting capacity of the listed breakers but the maximum possible short-circuit current is within the limits given in Tables C and D on pages on "Application of Oil Circuit-Breakers," a non-automatic starter may be used in series with a breaker having the automatic features of the starter, and of interrupting capacity high enough to suit the circuit conditions. Positive and speedy closing of the starter is particularly necessary in this case, and electrical operation should be used if such closing cannot otherwise be assured. Manual operation might prove unsatisfactory on large systems unless the attendants are fully aware of the necessity for positive operation.

### DISTINCTIVE FEATURES

The following features embodied in the construction of the breakers make them especially suitable for the service intended: Highly efficient form of wedge and finger-type contacts. Easy means of renewing the arcing tips (only a pair of pliers required). Submersion and opening of all contacts under a good head of oil. Positive and direct gravity break, assisted by spring tension. Strong sheet iron tanks (with all seams lap-welded and bottom flanged and welded) readily removable without disturbing the mechanism or contacts, thus making inspection and renewal of arcing tips easy. Contacts arranged so that auto-transformers are energized only during starting position except in the case of the QF breaker. Double-handle with

mechanical sequence interlock for motors that do not require preventive resistance during the starting period, thus obviating the possibility of short-circuiting the auto-transformer windings. Double-handle without interlock for motors requiring preventive resistance, thus permitting continuous application of graduated voltages on the motor during the starting application. Safety to operator insured by ample insulation in the breaker. Safety to apparatus insured by inverse-time-limit, automatic overload current-transformer trip coils, and by undervoltage release mechanism which opens the breaker when the voltage fails. Large short-circuit current interrupting ability.

## OIL CIRCUIT-BREAKERS FOR MOTOR STARTING—Continued

## OPERATION

See also Pages on "Oil Circuit-Breakers—General Information"

These breakers are manually operated. To start a motor with a circuit-breaker that has no preventive resistance the starting handle is moved down as far as it will go and held there until the motor has come up to speed. In this position the auto-transformers are magnetized and the motor is connected to the starting voltage. Then the starting handle is released, and the running handle is immediately moved down as far as it will go, where it remains latched. In passing to the running position, the auto-transformers are de-energized and full-line voltage is applied to the motor.

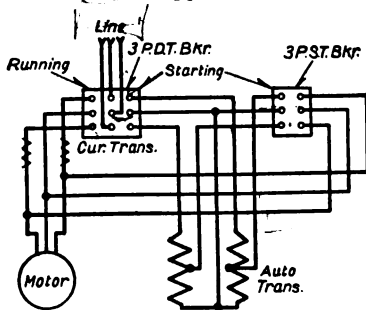


DIAGRAM OF CONNECTIONS FOR 3-PHASE MOTOR STARTING

Where a preventive resistance is used, the handle interlock is omitted and the starting handle is held down as before until the motor no longer gains speed, then the running handle is moved down before the starting handle is released, thus applying continuous voltage to the motor through the preventive resistance and preventing the shock resulting from full voltage being applied suddenly to the motor windings.

**Overload and Undervoltage Protection**—The inverse-time-limit feature is provided in connection with the automatic overload current-transformer trip coils on the breaker so that the motor circuit will not be opened on momentary overloads, such

as occur when changing from the starting to the running position. The time in which the automatic overload trip will operate is inversely proportional to the amount of the overload, tripping being instantaneous in case of a short circuit.

The breaker trips independently of the running handle so that the operator cannot hold it closed against an injurious overload.

The undervoltage release opens the contacts when the voltage has decreased to approximately one-half its normal value. This feature is provided to guard against an excessive current, due to the return of power to a motor which may be out of phase or at rest. The undervoltage coils operate directly from the motor circuit when the voltage does not exceed 550 volts; for voltages higher than 550 volts voltage transformers having a 100- or 110-volt secondary, and primary fuse blocks and fuses are required.

**Preventive Resistance**—Experience has shown that when the circuit of certain motors in general service is opened during the starting period, disturbances are produced which may be injurious to the motor winding when line voltage is applied to the motor. To prevent these disturbances a preventive resistance is used for two-pole and four-pole motors above 200 horsepower, motors above 200 horsepower that require full-load starting torque or greater, and for all motors of 500 horsepower and larger. With this preventive resistance the starting circuit is not opened till the running contacts are closed, this prevents the large rush of current that would otherwise occur where full voltage is applied. These cases should be referred to the company for proper application. It should be noted that the preventive resistance is in circuit during the starting period only.

## CONSTRUCTION

The type QF motor-starting oil circuit-breaker is a double-throw breaker with special moving and stationary contact arrangement. In effect, it is a three-pole, double-throw breaker with three additional terminals used to complete the auto-transformer circuits when the breaker is in a starting position.

**Mounting**—These breakers are furnished for panel-mounting, panel-frame mounting, and remote-control wall- and pipe-mounting, direct or reverse connected.

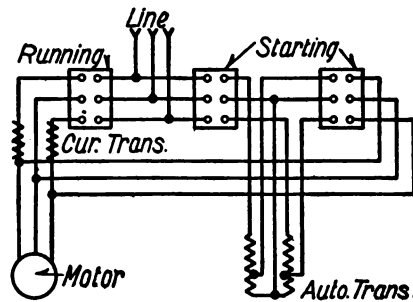


DIAGRAM OF CONNECTIONS FOR 3-PHASE MOTOR STARTING

## OIL CIRCUIT-BREAKERS FOR MOTOR-STARTING—Continued

**Tanks**—The tanks used are constructed in the same way as those used on the type F-2 and F-3 line of oil circuit-breakers.

**Mechanism**—The mechanism used is similar to that for the type F-33 oil circuit-breakers, except double-throw and interlocks may or may not be used. Two handles, one for starting and one for running, are provided on this breaker. These handles may or may not be mechanically interlocked, depending upon whether or not preventive resistance is used, so that one or both sides can be closed at a time. When an interlock is supplied it is a mechanical sequence interlock as described under "Small Oil Circuit-Breaker Accessories." The starting side is non-automatic; the running side is full-automatic (trip-free on overload) with undervoltage release and inverse-time-limit attachments.

It should be particularly noted that the remote-control breaker with **reverse connection** is different from the remote-control breaker with **direct connection**, due to the position of the breaker being reversed with respect to the operating handle on the front of the panel.

**Auto-Transformers**—The auto-transformers are mounted separately from the breakers. The tap leads of the transformers are permanently connected to the motor leads.

The type QF breaker is suitable for use with either two single-phase auto-transformers, or one three-phase auto-transformer. The three-phase auto-transformer for use with this breaker must have all nine leads brought out because the star connection must be made by the special contacts of the switch when it is in the starting position.

When a single set of auto-transformers specially designed for such service is to be used for starting two or more motors, complete data should be given to the company, as the connections require modification when group-starting is used.

Auto-transformers are not included with the circuit-breakers listed.

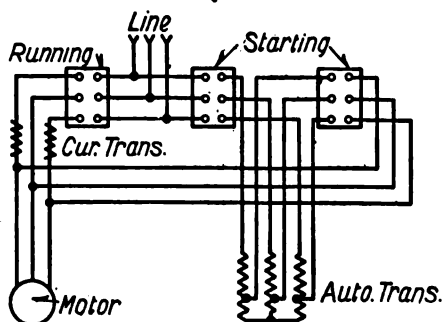


DIAGRAM OF CONNECTIONS FOR 3-PHASE MOTOR STARTING

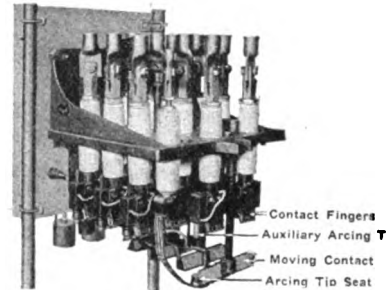
**Terminals**—The terminal bushings, terminal studs, terminals, and terminal lugs are the same as those used in the old type F oil circuit-breakers of similar capacity.

These circuit-breakers can be supplied with Frankel Solderless Connectors. For prices of these connectors see section on "Frankel Solderless Connectors."

**Main and Auxiliary Contacts**—The main contacts are of the regular well known type F-2 and F-3 oil circuit-breaker wedge type.

The auxiliary or arcing contacts are of the regular type F construction. They are of double the area of the regular type F auxiliary contact, thus giving a heavier auxiliary arcing tip.

The handles are interlocked so that the starting side must be completely closed and opened before the running side can be closed.



TYPE QF AUTO-STARTER WITH TANK REMOVED

The contacts on the starting side are the same for both the 300- and the 600-ampere capacity breakers; viz., the same size as the 300-ampere running contacts.

### Types F-11 and F-22 Motor Starting Breakers

In addition to the type QF breaker there are also available combinations of types F-11 and F-22 breakers for motor-starting service. These are three-breaker starters, one breaker being used to connect the auto transformer to the line, one to connect the auto transformer to the motor, and the third to connect the motor directly to the line. The auto transformer magnetizing breaker and the starting breaker are operated together from one handle of a double-handle coverplate, and the other breaker is operated from the other handle. In combinations of type F-11 breakers the magnetizing breaker and running breaker form the two throws of a double-throw breaker. The double-handle coverplate is equipped with overload trip with inverse-time-limit, with automatic retrieve undervoltage release, and mechanical sequence interlock. The double-handle coverplate used with these equipments differs from the standard one used with types F-11 and F-22 breakers in that the starting handle cannot be latched in, "Start" and "Run" nameplates are added over the handles, and it is adapted to operate with the automatic retrieve undervoltage release. For a complete description of these breakers and coverplates see section on "Types F-11 and F-22 Oil Circuit-Breakers."

These three-breaker starting arrangements disconnect the auto transformer at all times except during the starting period, while the QF breakers leave the auto transformer energized during the running period also.

OIL CIRCUIT-BREAKERS FOR MOTOR STARTING—Continued

INSTRUCTIONS FOR ORDERING

See also Pages on "Oil Circuit-Breakers—General Information"

In choosing a motor-starting breaker there are several considerations to be observed, the mere fact that the continuous-ampere rating of the breaker is equal to the maximum continuous overload current of the motor is not necessarily sufficient.

The following data must be carefully considered in determining the proper starting equipment for a motor:

- A—Full-load motor rating, including the amount and duration of overload guarantees.
- B—Nature of the load which the motor drives and the average number of starts that will be made per day.
- C—Current obtainable from the supply system in case of the dead short circuit between the switch and motor. If not known, give data so that this can be calculated. Such data will be:
  - (1)—Kilovolt-ampere capacity, and per cent reactance of synchronous machinery that can feed the power through the breaker.
  - (2)—Kilovolt-ampere capacity and per cent reactance of all step-up and step-down transformers between the synchronous machinery and motor-starting breaker.

APPLICATION OF MOTOR STARTING OIL CIRCUIT-BREAKERS

Table I following indicates which size of breaker may be used for a given size of motor on certain common commercial voltage systems and for different classes of service that the motor may drive. Motor service is divided respecting the effect of starting currents on the conducting parts of the breaker into two general classes (a) motor-generator set service, and (b) general service. Class (a) service will be less severe with regard to the burning of arcing tips than motors applied

- (3)—Size of wire or cable and length and spacing of conductors of all circuits between the synchronous machinery and the motor-starting breaker.
- D—Method of obtaining starting voltage, namely:
  - (a)—From two single-phase auto-transformers.
  - (b)—From one three-phase auto-transformer with neutral connection arranged to be made external from case.
  - (c)—Reduced voltage taps on secondary of step-down transformer. In this case a standard three-pole, double-throw type F-11 breaker sometimes may be used, depending on the size of the motor.
- E—(a)—Amperes in motor winding required to start the motor.
  - (b)—Amperes required to start the motor when connected to the reduced voltage starting-tap with tap voltage percentage.
  - (c)—Per cent of normal voltage required to start the motor.
- F—Motor amperes at full-voltage with motor locked.
- G—Will each motor have its own set of starting auto-transformers or will group-starting be employed?

to industrial machinery. The sizes of the motors of the motor-generator sets are for standard Westinghouse sets, which require approximately 30 per cent of full-load torque to start the set at 50 to 35 per cent full-line voltage. Similar size motors of motor-generator sets built by other manufacturers may be started by the breakers according to Table I, provided the starting torque and voltage are the same as for the corresponding standard Westinghouse motors.

TABLE I

Running Breaker	Magnetizing Breaker	Starting Breaker	MAXIMUM INTERRUPTING CAPACITY OF RUNNING BREAKER IN AMPS. AT					MAXIMUM CONTINUOUS AMPS. RATING OF STARTING BREAKERS FOR				MAXIMUM HP. OF MOTOR AT				
			110 Volts	220 Volts	440 Volts	550 Volts	2500 Volts	5 Sec.	30 Sec.	1 min.	2 min.	VOLTS				
												110	220	440	550	2500
200 Amp. 4500 Volt F-11	200 Amp. 4500 Volt F-11	200 Amp. 4500 Volt F-11	10000	10000	10000	10000	6500	10000	4000	3000	2000	45	90	180	200	400
400 Amp. 2500 Volt F-11	400 Amp. 2500 Volt F-11	400 Amp. 2500 Volt F-11	20000	20000	20000	20000	6500	20000	8000	6000	4000	90	180	360	400	500
600 Amp. 7500 Volt F-22	400 Amp. 2500 Volt F-11	400 Amp. 2500 Volt F-11	30000	30000	30000	30000	9000	20000	8000	6000	4000	135	270	540	600	800
800 Amp. 2500 Volt F-22	400 Amp. 2500 Volt F-11	400 Amp. 2500 Volt F-11	40000	40000	40000	33000	9000	20000	8000	6000	4000	180	360	735	800	1000
400 Amp. 7500 Volt F-22	400 Amp. 7500 Volt F-22	400 Amp. 7500 Volt F-22	20000	20000	20000	20000	9000	20000	8000	6000	4000	.....	.....	.....	.....	1000
300 Amp.	7500 Volt	QF	15000	15000	15000	15000	8600	20000	8000	6000	4000	75	225	290	300*	720†
600 Amp.	4500 Volt	QF	30000	30000	30000	30000	8600	20000	8000	6000	4000	145	290	500*	600*	.....

\*These ratings are based on 100% P. F., 50° rise, synchronous motors. For other applications derate as follows:  
 1. For 50° rise 80% synchronous motors use 75% of value in H. P.  
 2. For 40° rise 80% synchronous motors use 50% of value in H. P.  
 3. For 50° rise induction motors use 75% of value in H. P.  
 4. For 40° rise induction motors use 50% of value in H. P.  
 †There are no 50° rise, 100% motors of this capacity but these values may be derated for proper application according to rule.

OIL CIRCUIT BREAKERS FOR MOTOR STARTING—Continued

TABLE II—PRICES QF OIL CIRCUIT-BREAKERS

Style number and list price include the type QF motor-starting circuit-breaker complete as described, without oil or auto-transformer, which must be ordered separately. (See the general ordering instructions on the first pages on oil circuit-breakers.)

STYLE NUMBER*												List Price Each
NORMAL RATING OF UNDER VOLTAGE TRIP COIL												
Max. Cont. Amps.	Max. Volts	Interrupting Capacity at Rated Voltage Amperes	Gallons Oil	Approx. Shipping Wt., Lbs.	110 Volts, 60 Cycles	220 Volts, 60 Cycles and 110 Volts, 25 Cycles	440 Volts, 60 Cycles and 220 Volts, 25 Cycles	550 Volts, 60 Cycles	440 Volts, 25 Cycles	550 Volts, 25 Cycles		
<b>Direct Control—Panel Mounting†</b>												
300	7500	1900	15 1/4	337	321059	321071	321083	321095	321107	321119	\$422 50	
600	4500	4000	15 1/2	400	321060	321072	321084	321096	321108	321120	575 00	
<b>Direct Control—Panel Frame Mounting†</b>												
300	7500	1900	15 1/4	360	321061	321073	321085	321097	321109	321121	455 00	
600	4500	4000	15 1/2	430	321062	321074	321086	321098	321110	321122	600 00	
<b>Remote Control with Bell Cranks; Direct-Connected; Wall-Mounting‡</b>												
300	7500	2400	15 1/4	490	321063	321075	321087	321099	321111	321123	472 50	
600	4500	5000	15 1/2	552	321064	321076	321088	321100	321112	321124	625 00	
<b>Remote Control with Bell Cranks; Direct-Connected; Pipe-Mounting‡</b>												
300	7500	2400	15 1/4	490	321065	321077	321089	321101	321113	321125	472 50	
600	4500	5000	15 1/2	552	321066	321078	321090	321102	321114	321126	625 00	
<b>Remote Control with Bell Cranks; Reverse-Connected Wall-Mounting‡</b>												
300	7500	2400	15 1/4	490	321067	321079	321091	321103	321115	321127	472 50	
600	4500	5000	15 1/2	552	321068	321080	321092	321104	321116	321128	625 00	
<b>Remote Control with Bell Cranks; Reverse-Connected Pipe-Mounting‡</b>												
300	7500	2400	15 1/4	490	321069	321081	321093	321105	321117	321129	472 50	
600	4500	5000	15 1/2	552	321070	321082	321094	321106	321118	321130	625 00	

\*Style Number covers Breaker complete with undervoltage release attachment as indicated.  
 †Although the type QF motor-starting oil circuit-breakers are insulated for 4500- and 7500-volt service, engineering practice indicates that panel-mounting breakers should not be used on service voltages greater than 2500. For service voltages greater than 2500 remote-control breakers are required.  
 ‡For information as to what material is furnished with these breakers (nuts, cable terminals, etc.), see "Instructions for Ordering."  
 †Panel-mounting breakers are made for mounting on material two inches thick. When they are to be mounted on thinner material spacers must be used on the mounting bolts. The coverplates controlling remote-control manually-operated breakers are designed for mounting on 2-inch material. When these coverplates are to be mounted upon material less than 2 inches thick spacers must be used on mounting bolts; when they are to be mounted on material between 2 and 4 inches thick, longer mounting bolts than standard are required. Spacers or longer mounting bolts will be furnished free of charge when ordered with breakers.

TABLE III—PRICES THREE-PHASE STARTING COMBINATIONS

The style number and list price include the breaker combinations for three-phase motors complete with oil but without auto transformer, which must be ordered separately. See "Instructions for Ordering Oil Circuit-Breakers." Two 5-ampere overload trip coils with inverse-time-limit attachment and a sequence interlock are included. The undervoltage release attachment is included in the list price but is not included in the style number and should be ordered from the table below.

Circuit-Breaker Combinations for Motor Starting

Indoor-Wall Mounting\*—Remote Control

RUNNING BREAKER		MAGNETIZING BREAKER		STARTING BREAKER		Oil Gals.	WEIGHT†		Style No.	List‡ Price
Amps.	Type	Amps.	Type	Amps.	Type	Net	Ship.			
200	F-11	200	F-11	200	F-11	9	250	354	363429	\$325 00
400	F-11	400	F-11	400	F-11	9	270	374	363430	420 00
400	F-22	400	F-22	400	F-22	22 1/2	320	480	363431	505 00
600	F-22	400	F-11	400	F-11	14 1/2	340	506	363432	535 00
800	F-22	400	F-11	400	F-11	14 1/2	330	496	363433	605 00

\*Pipe mounting breakers may be obtained by adding two pipe mounting brackets Style No. 296764 for each breaker unit.  
 †Weight does not include oil. Net weight of oil is approximately 7 1/2 lbs. per gallon. Shipping weight is approximately 9 lbs. per gallon.  
 ‡List price includes undervoltage release attachment. Potential transformer for its operation, if required, must be ordered separately.  
 §The running and magnetizing breakers in these combinations form two throws of a double-throw type F-11 breaker. All other types F-11 and F-22 breakers in this table are three-pole single-throw.

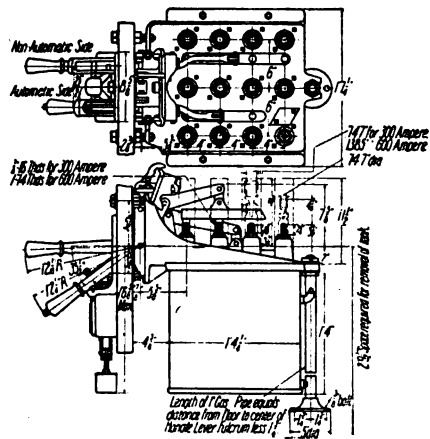
Automatic Retrieve Undervoltage Release Attachment§

Volts	STYLE No.	
	25-Cycle	60-Cycle
110	375189	375188
220	375190	375189
440	375191	375190
550	375192	375193

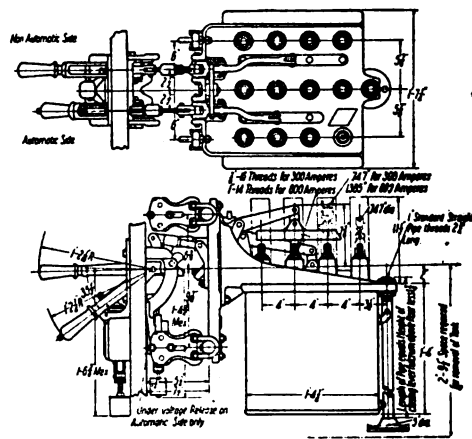
§These can be used only with double-handle cover plate Style No. 375091 which is supplied as part of the above motor starting equipments.

OIL CIRCUIT-BREAKERS FOR MOTOR-STARTING—Continued

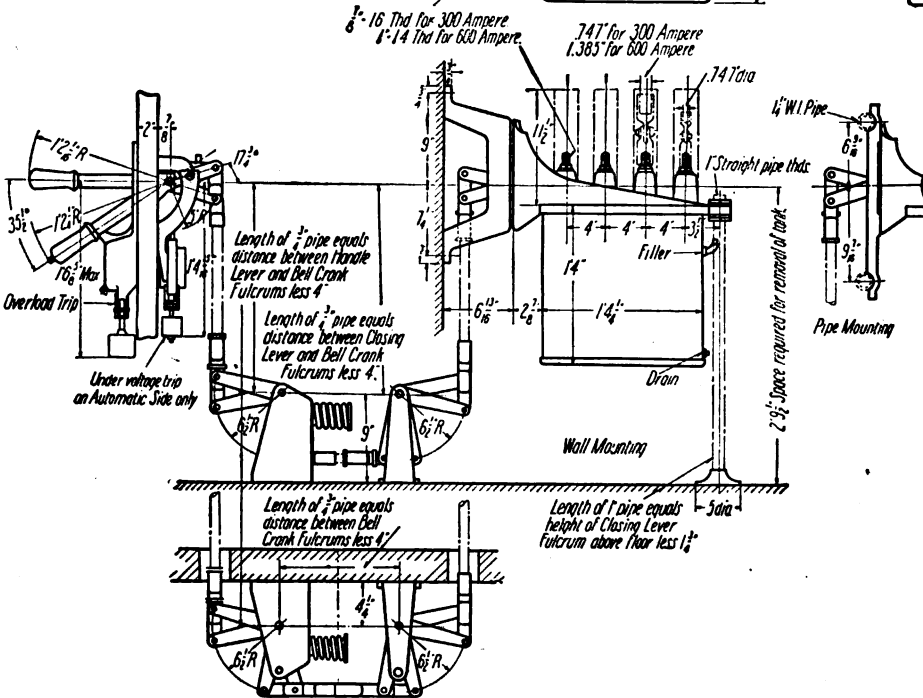
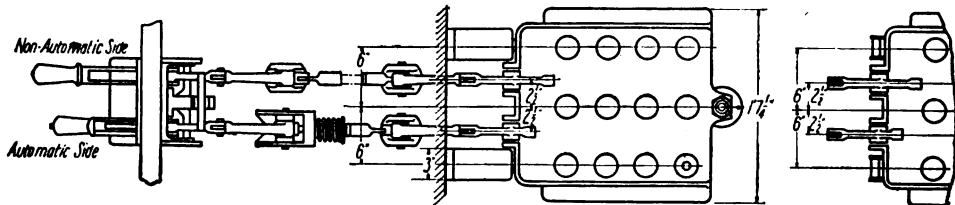
OUTLINE DIMENSIONS



TYPE QF FOR PANEL-MOUNTING



TYPE QF FOR PANEL-FRAME MOUNTING



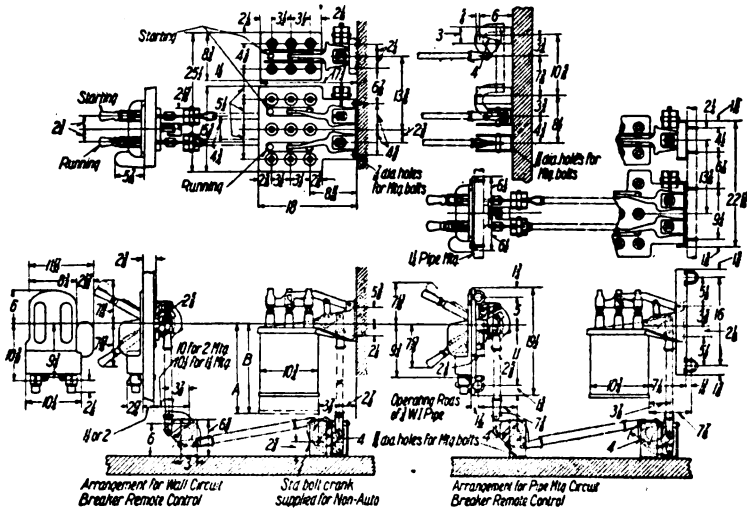
TYPE QF FOR DIRECT-CONNECTED REMOTE-CONTROL

QF breakers are all equipped with mechanical sequence interlock.

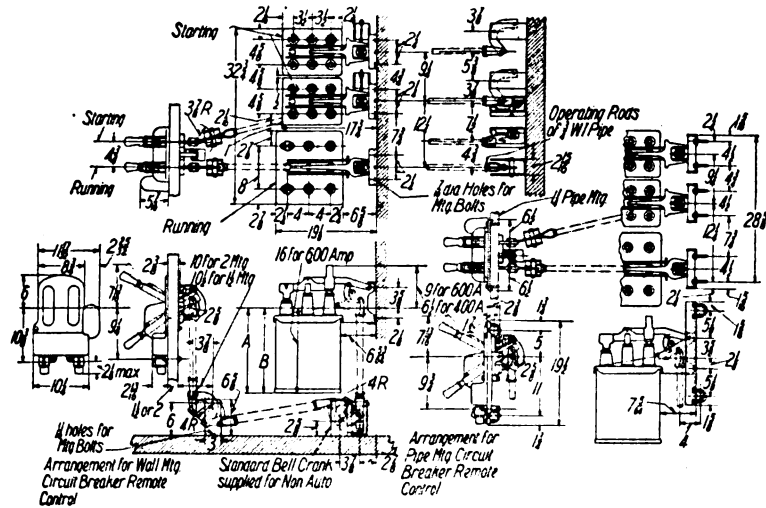
Reverse-connected remote-control breakers are the same as direct-connected remote-control, except that the breaker is mounted on the opposite side of the wall with respect to the coverplate—that is, in order to keep the arrangement of the coverplate the same, the parts of the breaker are reversed from left to right.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

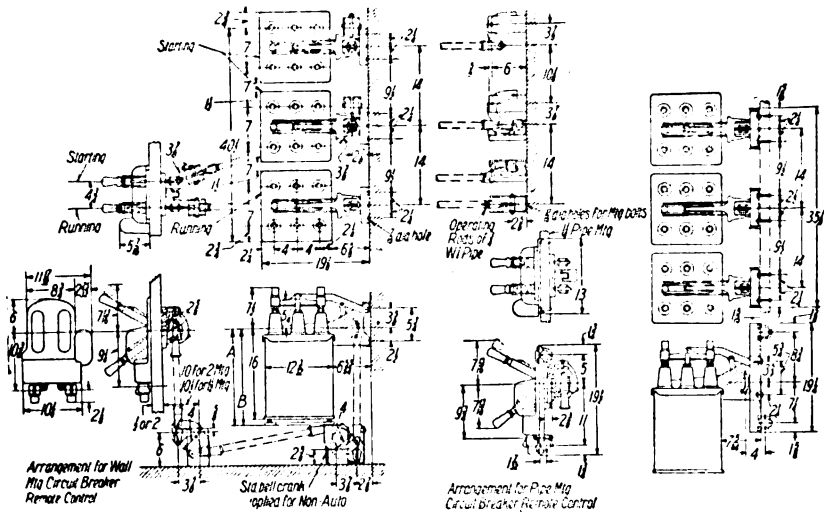
OIL CIRCUIT-BREAKERS FOR MOTOR STARTING—Continued



STYLE Nos. 363429 AND 363430



STYLE Nos. 363432 AND 363433



STYLE No. 363431

These dimensions are for reference only. For official dimensions apply to nearest district office.

## TYPE F OIL CIRCUIT-BREAKERS

### MANUALLY AND ELECTRICALLY-OPERATED NON-AUTOMATIC AND AUTOMATIC

#### FOR OUTDOOR AND SUBWAY SERVICE—SINGLE THROW

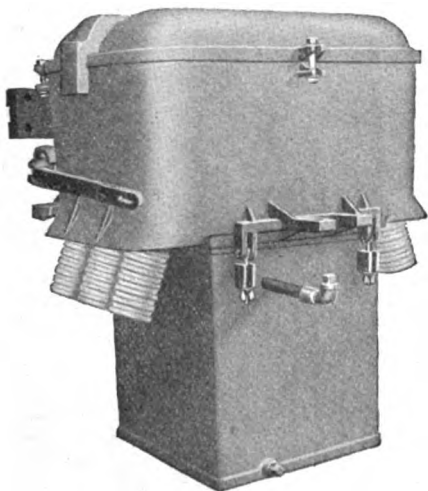
For Capacities of 200, 600 and 800 Amperes 4500, 7500 and 15,000 Volts, A-C.  
Respectively

#### Interrupting Capacities at Rated Voltage, 1400 to 15,000 Amperes

##### Application

See also Pages on "Oil Circuit-Breaker Application"

The type F oil circuit-breakers comprise a line of moderate-capacity, non-automatic and automatic manually and electrically-operated breakers for outdoor service in pole or subway-mounting forms.



TYPE F-3 WEATHERPROOF ELECTRICALLY- OR MANUALLY-OPERATED WALL- OR PIPE-MOUNTING THREE-POLE SINGLE-THROW 600-AMPERE 7500-VOLT

The outdoor form of wall- or pole-mounting breaker is primarily intended for service in exposed places. It is particularly adapted to controlling lines where they enter buildings, for controlling branch feeders from main lines, for sectionalizing feeders, for cutting out transformers, or for any of the other numerous purposes for which an outdoor form of breaker may be utilized on distribution systems. It is also adapted to use with motor installations, because of the ease with which the breaker may be mounted on any vertical support convenient to the motor operator.

The subway form of breaker is intended for mounting in subways, manholes, or other places where a breaker may be required to operate submerged. The subway form of breaker is made two- or three-pole single-throw for capacities up to 300 amperes 7500 volts.

##### Distinctive Features

Among the features that distinguish the type F breakers are: Highly efficient form of wedge and

finger-type contacts. Auxiliary arcing contacts. Submersion and opening of all contacts under oil. Quick opening of contacts, assisted by arcing tip springs. Open position maintained by gravity. Inability to hold full-automatic breaker in the closed position when an excessive overload or short circuit exists on the line. Strong tanks and tank supports. Tanks removable without disturbing the operating mechanism or contacts, making inspection easy. Ample air space at the top of the tank to allow for gas expansion. Insulating lining in the tanks. Isolation of poles by individual cells. Self-contained multipole hand- or electric-operated mechanism on the multipole single-tank breakers.

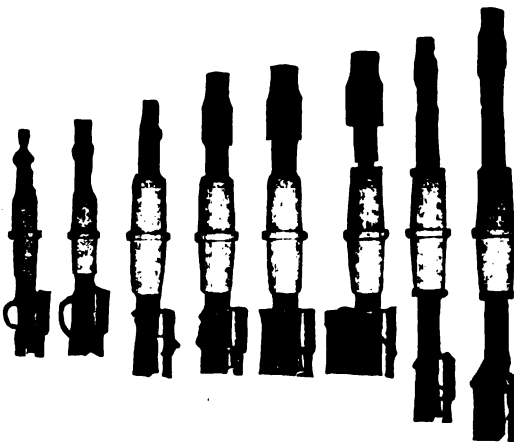
##### Operation

See also Pages on

"Oil Circuit-Breakers—General Information"

The type F circuit-breakers are non-automatic and full-automatic, direct-control manually-operated; and non-automatic and automatic electrically-operated.

The non-automatic breakers are used where voltage, breaking capacities, and current capacities are required greater than those listed for the type D oil breakers.



LINE OF TYPE F STATIONARY-CONTACT PILLAR UNITS WITH TERMINALS

**Automatic Breakers**—All manually-operated automatic breakers listed are full-automatic.

**Plain automatic overload-trip breakers**, when closed with an overload on the line, will remain closed as long as the closing coil is energized, but will not remain closed when the closing circuit is opened.



## TYPE F OIL CIRCUIT-BREAKERS—Continued

**Full-automatic overload-trip breakers** have a mechanism making it impossible to hold the breaker in the closed position while a continued overload condition or a short circuit exists on the line.

**Standard Overload Trip-Range**—The standard overload-trip range of these breakers is 80 to 160 per cent of the normal full-load current rating or primary rating of the current transformer or series-trip coil in the trip-coil circuit.

**Series Overload Trip**—The breakers have the tripping coils connected in series with the line. With these breakers no current transformers are required for overload purposes.

**Series-Transformer Overload Trip**—The 500-ampere, 600-ampere, and 800-ampere, type F-3 automatic, overload, weatherproof breakers are equipped with bushing-type current transformers. These transformers energize the trip coils proper, which trip the breaker.

For three-phase grounded circuits the type F-3 breakers may be supplied on special order, in capacities of 200 amperes and above, with three bushing-type current transformers and two trip coils connected in Z which gives full protection. Note, however, that the 500-ampere breaker is the smallest breaker that can be used in this application. The 500-ampere breaker is furnished for the 200-to 500-ampere capacity equipment.

### Construction

See also pages on "Oil Circuit-Breakers  
General Information"

#### Outdoor Form

The wall- or pole-mounting breakers are listed in the type F-1 and F-3 forms only.

The type F-1 breakers are listed in weatherproof cases, two, three and four-pole. These breakers are manually-operated full-automatic with series-trip coils and adjustable time-element dashpots immersed in the oil, and thus protected from moisture. They can be equipped on special order with a self-resetting undervoltage release device enclosed in the case under the cover. The undervoltage release coils can be connected directly in the circuit on voltages up to 550, but on higher voltages, separate weatherproof voltage transformers are required.

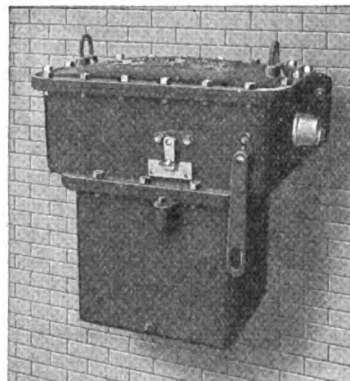
These breakers are being used for the control of motors in connection with drum controllers. For these applications an electrical lock-out device to prevent the closing of the breaker unless the controller is in the "off" position and can be furnished on special order.

In the 750-volt breakers, the contact support is a slate base and in the 4500-volt it is of vertical porcelain pillars. The terminals are inside the case in the 750-volt breakers, and in the 4500-volt the leads are brought outside the case. When so ordered, these breakers will be supplied for conduit wiring and at the same price as the listed breakers. The conduit wiring breakers differ from the listed breakers in that the insulations for leads are omitted, and the breaker housing is drilled for the conduit.

#### Breaker with Cover for Mounting an Ammeter—

The type F-1 weatherproof breakers with covers for mounting self-contained ammeters are listed for indoor service only. These ammeter-mounting breakers are dustproof, but not weatherproof. The type SM self-contained ammeter, up to and including 200 amperes, will be furnished. When ammeters of greater than 200 amperes capacity are required, the 5-ampere ammeter should be used in connection with the proper current transformer. For complete data on ammeters, refer to section 3-B of this catalogue captioned "Westinghouse Instruments and Relays." The ammeter selected should be such that it will not be injured by the maximum current that may pass through the breaker.

The type F-3 breakers are listed both manually- and electrically-operated, in weatherproof cases two- and three-poles. They are listed for both full-automatic and non-automatic operation. The full-automatic breakers have series-trip coils and adjustable inverse-time-element dashpots immersed in oil. They can be equipped with 5-ampere coils for use in direct-connection with current transformers or relays for any reasonable tripping range.



TYPE F-1 SUBWAY MANUALLY-OPERATED AUTOMATIC  
SERIES-TRIP WITH REVERSE-TIME-ELE-  
MENT, THREE-POLE SINGLE-THROW  
300-AMPERE 750-VOLT

#### Subway Form

The subway form of breaker is listed in the type F-1 and F-2 forms only.

The type F-1 breakers are supplied in two and three poles for subway or manhole mounting. They are manually-operated, full-automatic series trip with the trip coils and adjustable inverse-time-element dashpots mounted in the oil inside the case. They are completely waterproof so that they can be immersed, if necessary.

The type F-2 electrically-operated breakers are listed in two and three poles for subway or manhole mounting. They are made for electric operation, full-automatic and non-automatic only, and have series-trip coils and adjustable inverse-time-element dashpots in the oil inside the case.

## TYPE F OIL CIRCUIT-BREAKERS—Continued

If desired on special order, 5-ampere trip coils can be supplied and used in connection with current transformers. The electrically-operated non-automatic breakers can be used as automatic by actuating them from appropriate current transformers and shunt trip relays.

**Caution—Care should be taken, when ordering to specify the proper outlet bushings for subway breakers.**

**Construction—General**

**Tanks**—Multipole-single-tank construction is used on all listed type F-1, F-2 and F-3 breakers. The oil tanks are rectangular in shape and are made of heavy sheet iron, with all seams lap-welded, the bottom being flanged and welded on the outside of the tank sides except the subway form which has a heavy cast iron tank. As an additional protection from arcing, individual insulating cells form separate compartments for each pole where one tank is used on multipole-breakers.

The method of fastening the tank to the frame, while very secure, yet permits an easy removal for the purpose of inspection and repair. The supporting frame of the breaker has a flange which encloses the upper end of the tank when in place, thus preventing the tank from distortion under heavy internal pressure.

The tanks are deep to allow ample space above the oil level to act as an expansion chamber for the arc gases and to reduce slopping of the oil from internal disturbances. The gases are vented through the clearance between the wooden operating rods and the frame.

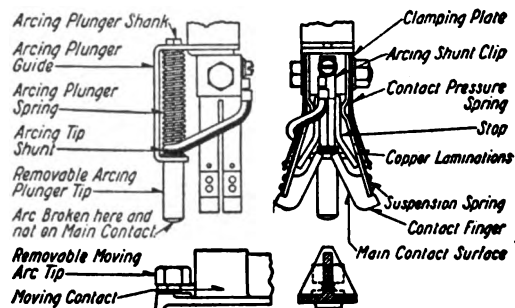
**Tank Linings**—All the outdoor and subway, Type F breakers, have micarta tank linings. Seamless moulded micarta linings can be supplied for these breakers on special order, similar to the standard linings for type F-33 breakers. Prices on application.

**Terminal Bushings and Studs**—The terminal studs or bushings with stationary contacts or feet on the lower extremity are supported in the 750-volt type F-1 breakers on a slate base, and in the other listed breakers by one-piece vertical pillar-type porcelain bushings clamped to the framework. The studs and micarta-tube details are clamped to these insulators. This construction avoids the use of babbitt and cement, and thus reduces the time and labor of maintenance. Lock washers are used on the clamped bolts and current-carrying parts to prevent them from loosening by vibration or hammer blows, which might occur in the operation of the breaker.

**Terminals and Terminal Lugs**—Copper tube terminals are supplied on breakers up to and including the 800-ampere capacity 60-cycle rating. The terminals are connected to the stud by two contact nuts. On order, special terminals may be supplied, but no allowance is made for the omission of the terminals regularly supplied with the breaker when special terminals are ordered, since the

special terminals are shipped as an additional item. For special terminals or contact nuts, see pages on "Oil Circuit-Breaker Accessories" and section on "Westinghouse-Frankel Solderless Connectors."

The main moving contacts are of an improved wedge type. The main stationary contacts consist of fingers of the "controller" type arranged in pairs facing each other so as to make perfect contact on the two surfaces of the moving-contact wedge when the breaker is closed. The contact tips on the end of the fingers are supported on the ends of thin flat steel springs, permitting the contact to move in all directions and to automatically align itself on the wedge, thus insuring that the full carrying capacity of the contacts is always available. This spring is shunted by a liberal copper-leaf shunt to conduct the current from the tips



DETAILS OF TYPE F CONTACTS SHOWING MAIN-CONTACT FINGERS AND ARCING TIPS USED ON 300-AMPERE BREAKERS

to the terminal stud. The contact pressure is obtained by a second and heavier flat steel spring which is provided on the end with a round head and which applies the pressure over the center of the contact tip of the finger. One or more pairs of fingers are used according to the capacity of the breaker (see illustrations).

A steel stop is mounted between the fingers on the contact stud and serves to hold the fingers in the proper position when the breaker is open so that there is no danger of the moving contacts failing to enter between the stationary fingers upon closing the breaker. This stop also causes the fingers to be under considerable initial tension at the time the moving contact first touches them in closing, or leaves them in opening the breaker, reducing the liability of contact vibration and burning with abnormal currents flowing.

**Arcing contacts** of the butt type protect the main contact from the action of arcs at breaking. The stationary member consists of a spring plunger and copper arcing tip mounted on the support of the main contact. A flexible copper wire shunt carries the current from the stud to this tip. A copper bolt is carried on the conducting cross-bar of the moving contact element and serves as the moving arcing contact. The auxiliary arcing contacts maintain contact for a considerable distance after the main-contact fingers have broken contact.

TYPE F OIL CIRCUIT-BREAKERS—Continued

This time interval is predetermined by the amount of separation of the main-contact fingers produced by the steel stop already referred to, and serves to fully protect the main contacts.

The construction is such that the entire breaker may be assembled and lined up and the contacts adjusted from under the frame before placing the tanks in position. This feature of accessibility of contacts is of very material advantage in securing quick and accurate repair and adjustments.

Style number includes the breaker complete as described and listed with oil. See also "Instructions for Ordering Oil Circuit-Breakers." These breakers do not have excessive insulation and should not be installed on lines subject to surges above the insulation test value given in rule 7323 of the April, 1921, edition of "Standard Rules of the A.I.E.E.," unless protected by lightning arresters or other surge protective devices.

TABLE I—TYPE F-1 WEATHERPROOF MANUALLY-OPERATED SINGLE-THROW\*\*

Series-Trip Full-Automatic With Inverse-Time-Limit Attachment

Maximum Continuous Amperes	Interrupting Capacity at Rated Voltage, Amperes	TWO-POLE		THREE-POLE		FOUR-POLE	
		Style No.	List Price	Style No.	List Price	Style No.	List Price
For Voltages up to 750							
5	500	205192	\$118 00	205202	\$141 00	205212	\$189 00
10	1000	205193	118 00	205203	141 00	205213	189 00
15	1500	205194	118 00	205204	141 00	205214	189 00
25	2500	205195	118 00	205205	141 00	205215	189 00
50	5000	205196	118 00	205206	141 00	205216	189 00
75	7500	205197	118 00	205207	141 00	205217	189 00
100	10000	205198	118 00	205208	141 00	205218	189 00
150	10000	205199	134 00	205209	163 00	205219	215 00
200	10000	205200	138 00	205210	165 00	205220	220 00
300	15000	205201	140 00	205211	168 00	205221	225 00
For Voltages up to 4500							
5	500	205222	148 00	205231	178 00	205240	235 00
10	1000	205223	148 00	205232	178 00	205241	235 00
15	1500	205224	148 00	205233	178 00	205242	235 00
25	1600	205225	148 00	205234	178 00	205243	235 00
50	1600	205226	150 00	205235	182 00	205244	240 00
75	1600	205227	150 00	205236	182 00	205245	240 00
100	1600	205228	150 00	205237	182 00	205246	240 00
150	1600	205229	166 00	205238	200 00	205247	262 00
200	1600	205230	170 00	205239	205 00	205248	272 00

Poles	FOR VOLTAGES UP TO 750		FOR VOLTAGES UP TO 4500	
	Gallons Oil	Approximate Shipping Wt. Lbs.*	Gallons Oil	Approximate Shipping Wt. Lbs.*
2	4½	150	4½	155
3	4½	155	4½	160
4	6	175	6	182

Undervoltage Release Attachments††

For Use Only When Ordered Complete with F-1 Weatherproof Breaker Only

Description	Style No.	ADDITIONAL LIST PRICE—Mechanism	
		Complete With Coil Voltage 110-220	Voltage 440-550
Mechanism with cover for 2 and 3-pole, 750-volt breakers above.....	205249	\$39 00	\$41 00
Mechanism with cover for 4-pole 750-volt breakers above.....	205250	39 00	41 00
Mechanism for 2, 3, and 4-pole, 4500-volt breakers above.....	205251	39 00	41 00

For use with type F-1 weatherproof oil circuit-breakers only; for accessories for use with other than type F-1 weatherproof breakers, refer to "Small Oil Circuit-Breaker Accessories."

Ammeter-Mounting Covers For Type F-1 Weatherproof Breakers Only††

These covers replace the covers ordinarily furnished and provide a suitable mounting for an ammeter as previously described.

Description	Additional List Price
For 2 and 3-pole breakers.....	\$13 50
For 4-pole breakers.....	14 80

For use with type F-1 weatherproof oil circuit-breakers only; for accessories for use with other than type F-1 weatherproof breakers, refer to "Small Oil Circuit-Breaker Accessories."

\*\*The breakers can be supplied for conduit wiring on special order—see general description for data.

\*Weight does not include oil. Shipping weight of oil is approximately 9 pounds per gallon.

†In ordering undervoltage release specify style number and state voltage and frequency of circuit. The standard voltage coils are 110, 220, 440, and 550 volts for 25 and 60-cycle circuits. Other voltages and frequencies are special with prices on application. For use on voltages over 750, specify 110-volt coil and order in addition the necessary voltage transformer. See pages on "Voltage Transformers" in section on "Instruments and Relays" for style number and price.

††Table II lists style numbers of complete breakers with and without ammeter-mounting cover and with and without undervoltage release attachment.

††For ammeters used in connection with these covers, on the type F-1 weatherproof oil circuit-breakers refer to previous pages and for the voltage rating of the ammeters used refer to catalogue section 3-B.

For information as to what material is furnished with these breakers, see "Instructions for Ordering" on a previous page.

TYPE F OIL CIRCUIT-BREAKERS—Continued

TABLE II—TYPE F-1 WEATHERPROOF MANUALLY-OPERATED SINGLE-THROW\*\*

Series-Trip Automatic-Overload With Inverse-Time-Limit Attachment

Rating of Under Voltage Trip Coil 25- 60- Cycle Cycle	Poles	Approx. Shipping Wt.* Lb. Net	STYLE No.										List Price
			5-Amp.	10-Amp.	15-Amp.	25-Amp.	50-Amp.	75-Amp.	100-Amp.	150-Amp.	200-Amp.	300-Amp.	

Without Ammeter-Mounting Cover—With Undervoltage-Release Attachment†

For Voltages up to 750

110	220	2	150	268761	268762	268763	268764	268765	268766	268767	268768	268769	268770	
110	220	3	165	268771	268772	268773	268774	268775	268776	268777	268778	268779	268780	
110	220	4	185	268781	268782	268783	268784	268785	268786	268787	268788	268789	268790	
220	{440}	2	150	268791	268792	268793	268794	268795	268796	268797	268798	268799	268800	
220	{550}	3	165	268801	268802	268803	268804	268805	268806	268807	268808	268809	268810	
220		4	185	268811	268812	268813	268814	268815	268816	268817	268818	268819	268820	
440		2	150	268821	268822	268823	268824	268825	268826	268827	268828	268829	268830	
440		3	165	268831	268832	268833	268834	268835	268836	268837	268838	268839	268840	
440		4	185	268841	268842	268843	268844	268845	268846	268847	268848	268849	268850	
550		2	150	268851	268852	268853	268854	268855	268856	268857	268858	268859	268860	
550		3	165	268861	268862	268863	268864	268865	268866	268867	268868	268869	268870	
550		4	185	268871	268872	268873	268874	268875	268876	268877	268878	268879	268880	
110		2	150	268881	268882	268883	268884	268885	268886	268887	268888	268889	268890	
110		3	165	268891	268892	268893	268894	268895	268896	268897	268898	268899	268900	
110		4	185	268901	268902	268903	268904	268905	268906	268907	268908	268909	268910	

For Voltages up to 4500††

110		2	165	268911	268912	268913	268914	268915	268916	268917	268918	268919	None	
110		3	170	268920	268921	268922	268923	268924	268925	268926	268927	268928	None	
110		4	192	268929	268930	268931	268932	268933	268934	268935	268936	268937	None	
110		2	165	268938	268939	268940	268941	268942	268943	268944	268945	268946	None	
110		3	170	268947	268948	268949	268950	268951	268952	268953	268954	268955	None	
110		4	192	268956	268957	268958	268959	268960	268961	268962	268963	268964	None	

With Ammeter-Mounting† Cover—With Undervoltage-Release Attachment†

For Voltages up to 750

110	220	2	190	268965	268966	268967	268968	268969	268970	268971	268972	268973	268974	
110	220	3	185	268975	268976	268977	268978	268979	268980	268981	268982	268983	268984	
110	220	4	205	268985	268986	268987	268988	268989	268990	268991	268992	268993	268994	
220	{440}	2	180	268995	268996	268997	268998	268999	269000	269001	269002	269003	269004	
220	{550}	3	185	269005	269006	269007	269008	269009	269010	269011	269012	269013	269014	
220		4	205	269015	269016	269017	269018	269019	269020	269021	269022	269023	269024	
440		2	180	269025	269026	269027	269028	269029	269030	269031	269032	269033	269034	
440		3	185	269035	269036	269037	269038	269039	269040	269041	269042	269043	269044	
440		4	205	269045	269046	269047	269048	269049	269050	269051	269052	269053	269054	
550		2	180	269055	269056	269057	269058	269059	269060	269061	269062	269063	269064	
550		3	185											
550		4	205											
110		2	180											
110		3	185											
110		4	205											

For Voltages up to 2200

110		2	185	269065	269066	269067	269068	269069	269070	269071	269072	269073	269074	None
110		3	190	269084	269085	269086	269087	269088	269089	269090	269091	269092	269093	None
110		4	210	269094	269095	269096	269097	269098	269099	269100	269101	269102	269103	None
110		2	185	269103	269104	269105	269106	269107	269108	269109	269110	269111	269112	None
110		3	190	269112	269113	269114	269115	269116	269117	269118	269119	269120	269121	None
110		4	210											

With Ammeter-Mounting† Cover—Without Undervoltage-Release Attachment

For Voltages up to 750

None	2	170	269065	269066	269067	269068	269069	269070	269071	269072	269073	269074	
None	3	175	269075	269076	269077	269078	269079	269080	269081	269082	269083	269084	

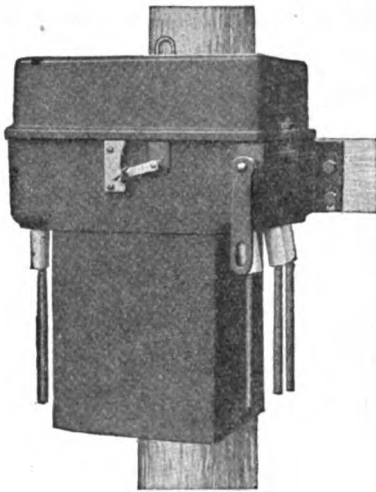
For Voltages up to 4500††

None	2	175	269121	269122	269123	269124	269125	269126	269127	269128	269129	None	
None	3	180	269130	269131	269132	269133	269134	269135	269136	269137	269138	None	

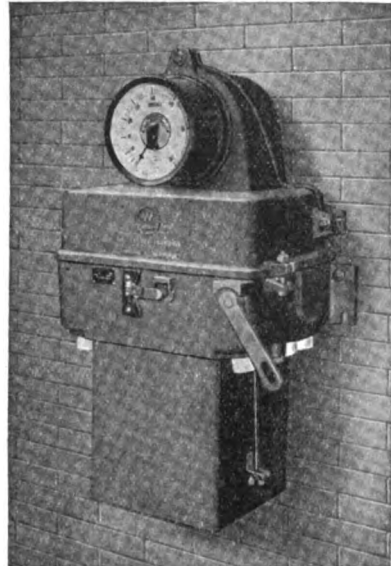
Interrupting Capacity—For interrupting capacity at rated voltage see corresponding Breakers on previous page.  
 Oil—Two and three-pole breakers require 4½ gallons of oil, four-pole, 6 gallons.  
 \*\*The breakers can be supplied for conduit wiring on special order—see general description for data.  
 \*Weight does not include oil. Shipping weight of oil is approximately 9 pounds per gallon.  
 †Breaker style numbers and weights do not include ammeter. Select type SM Ammeter from catalogue section on "Instruments and Relays." List prices do not include the ammeters. Breakers with ammeter-mounting cover are not weatherproof—see description on previous page.  
 ††Other voltages and frequencies of undervoltage are special; prices on request. For use on voltages over 600 specify breaker with 110-volt coil and order in addition the necessary voltage transformers. See voltage transformers in section on "Instruments and Relays" for style number and prices.  
 ‡List price is the sum of the list prices of the corresponding breaker, ammeter-mounting cover, and undervoltage-release attachment listed in Table I.  
 †††The voltage rating of 4500 refers to the type F-1 Weatherproof Oil Circuit-Breaker rating given in table. For the ammeter voltage rating refer to catalogue section 3-B.  
 For information as to what material is furnished with these breakers, see "Instructions for Ordering" on a previous page.

Order by Style Number

TYPE F OIL CIRCUIT-BREAKERS—Continued



TYPE F-1 WEATHERPROOF MANUALLY-OPERATED AUTOMATIC SERIES-TRIP WITH INVERSE-TIME-ELEMENT, THREE-POLE SINGLE-THROW 200-AMPERE 4500-VOLT



TYPE F-1 WEATHERPROOF BREAKER WITH BRACKET FOR MOUNTING AN AMMETER

TABLE III—TYPE F-3 WEATHERPROOF SINGLE-THROW

Max. Continuous Amp.	Max. Volts	Amperes Interrupting Capacity at Rated Voltage	MANUALLY-OPERATED				ELECTRICALLY-OPERATED			
			TWO-POLE		THREE-POLE		TWO-POLE		THREE-POLE	
			Style No.	List Price	Style No.	List Price	Style No.	List Price	Style No.	List Price
<b>Series-Trip, Full-Automatic With Inverse Time Element†</b>										
5	7500	500	248236	\$462 00	248237	\$495 00	248238	\$558 00	248239	\$580 00
10	7500	1000	216951	462 00	216962	495 00	216901	558 00	216912	580 00
25	7500	2500	216952	462 00	216963	495 00	216902	558 00	216913	580 00
50	7500	2900	216953	462 00	216964	495 00	216903	558 00	216914	580 00
75	7500	2900	216954	462 00	216965	495 00	216904	558 00	216915	580 00
100	7500	2900	216955	462 00	216966	495 00	216905	558 00	216916	580 00
150	7500	2900	216956	462 00	216967	495 00	216906	558 00	216917	580 00
200	7500	2900	216957	462 00	216968	495 00	216907	558 00	216918	580 00
300	7500	2900	216958	462 00	216969	495 00	216908	558 00	216919	580 00
500‡	7500	2900	216959	515 00	216970	585 00	216909	620 00	216920	685 00
600‡	7500	2900	216960	550 00	216971	640 00	216910	675 00	216921	750 00
800‡	4500	4800	216961	595 00	216972	695 00	216911	740 00	216922	820 00
<b>Non-Automatic†</b>										
5	15000	500	216973	495 00	216982	585 00	216931	615 00	216940	670 00
10	15000	1000	216974	495 00	216983	585 00	216932	615 00	216941	670 00
15	15000	1400	216975	495 00	216984	585 00	216933	615 00	216942	670 00
25	15000	1400	216976	495 00	216985	585 00	216934	615 00	216943	670 00
50	15000	1400	216977	495 00	216986	585 00	216935	615 00	216944	670 00
75	15000	1400	216978	495 00	216987	585 00	216936	615 00	216945	670 00
100	15000	1400	216979	495 00	216988	585 00	216937	615 00	216946	670 00
150	15000	1400	216980	495 00	216989	585 00	216938	615 00	216947	670 00
200	15000	1400	216981	495 00	216990	585 00	216939	615 00	216948	670 00
200	7500	2900	248240	412 00	248241	440 00	248242	500 00	248243	525 00
300	7500	2900	221970	412 00	221974	440 00	216923	500 00	216927	525 00
500	7500	2900	221971	435 00	221975	462 00	216924	525 00	216928	545 00
600	7500	2900	221972	455 00	221976	512 00	216925	545 00	216929	595 00
800	4500	4800	221973	525 00	221977	595 00	216926	635 00	216930	675 00
200	15000	1400	.....	.....	.....	.....	216949	675 00	216950	645 00

Electrically-Operated Breakers

4500 Volts and 7500 Volts‡

Poles	Gallons Oil	Approx. Ship. Wt., Lbs.*
2	13	600
3	13	613

\*Weight does not include oil. Shipping weight of oil is approximately 9 pounds per gallon.

†Full-automatic breakers can be supplied on special order with 5-ampere trip coils for transformer trip. List price same as listed for 10-ampere series-trip breaker above.

‡Dimensions, weights, and amount of oil for 15,000-volt breakers will be supplied on request.

§Equipped with current transformers, self-contained, which energize the trip coil, or coils, proper.

Type F-3 Weatherproof Oil Circuit-Breaker Undervoltage Release Attachment

For Use Only When Ordered Complete with Breaker

List price includes the undervoltage release attachment complete with coil. In ordering specify mechanism from above with proper coil for voltage and frequency required. The coil style numbers will be found under the listings of the type F-33 indoor breakers.

Mechanism for hand-operated breaker, Style No. 363424.....	List Price
Mechanism for electrically operated breaker, Style No. 363425.....	\$45 00
	50 00

TYPE F OIL CIRCUIT-BREAKERS—Continued

TABLE IV—SUBWAY SINGLE-THROW§

Wall-Mounting Series-Trip Full-Automatic† With Inverse-Time-Limit Attachment

For Voltages up to 7500.

Maximum Continuous Amperes	Amperes Interrupting Capacity at Rated Voltage	TWO-POLE		THREE-POLE	
		Style No.	List Price	Style No.	List Price
<b>Type F-1 Manually-Operated</b>					
10	960	193579	\$387 00	193587	\$450 00
25	960	193580	387 00	193588	450 00
50	960	193581	387 00	193589	450 00
75	960	193582	387 00	193590	450 00
100	960	193583	387 00	193591	450 00
150	960	193584	387 00	193592	450 00
200	960	193585	400 00	193593	482 00
300	960	193586	400 00	193594	482 00
<b>Type F-2‡ Electrically-Operated</b>					
5	500	218991	550 00	217000	645 00
10	1000	218992	550 00	217001	645 00
25	1700	218993	550 00	217002	645 00
50	1700	218994	550 00	217003	645 00
75	1700	218995	550 00	217004	645 00
100	1700	218996	550 00	217005	645 00
150	1700	218997	550 00	217006	645 00
200	1700	218998	585 00	217007	675 00
300	1700	218999	585 00	217008	675 00

Poles	TYPE F-1		TYPE F-2		Diameter of Hole	Style No.	List Price
	Gallons Oil	Approx. Shipping Wt. Lb.*	Gallons Oil	Approx. Shipping Wt. Lb.*			
2	8	240	9 1/2	...	3/4	219970	\$4 95
3	8	260	9 1/2	...	3/4	47808	4 95
					1	60010	4 95
					1 1/4	47889	5 45
					1 1/2	59932	5 95

§Style number and list price of subway breakers do not include cable bushings. These bushings should be ordered extra as follows:

One per lead of proper size for cable, or, 2 per breaker of proper size that each will take all leads on one side.

\*Weight does not include oil. Shipping weight of oil is approximately 9 pounds per gallon.

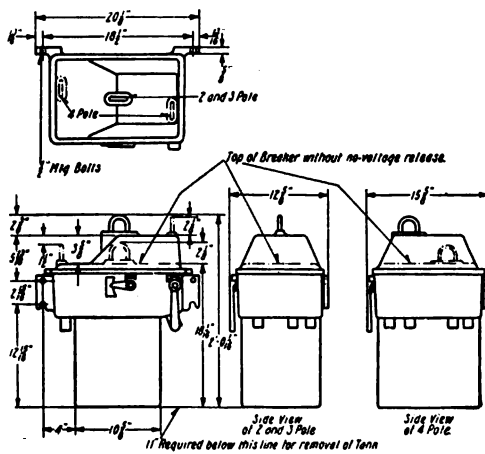
†Type F-1 hand-operated 300-ampere and type F-2 electrically-operated 300, 500, and 600-ampere non-automatic breakers can be supplied on special order at the same price as the automatic breakers.

‡Type F-2 automatic breakers can be supplied on special order in capacities of 500 amperes for use on circuits of voltages up to 7500 and 600 amperes on circuits up to 4500. Prices on application.

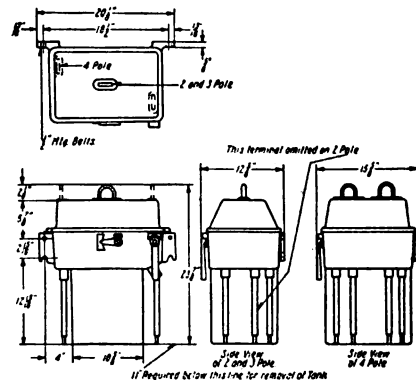
For information as to what material is furnished with these breakers, see "Instructions for Ordering" on a previous page.

OUTLINE DIMENSIONS

TYPE F-1 WEATHERPROOF, SINGLE-THROW, OIL CIRCUIT-BREAKERS



STYLE NOS. 205192 TO 205221 INCLUSIVE

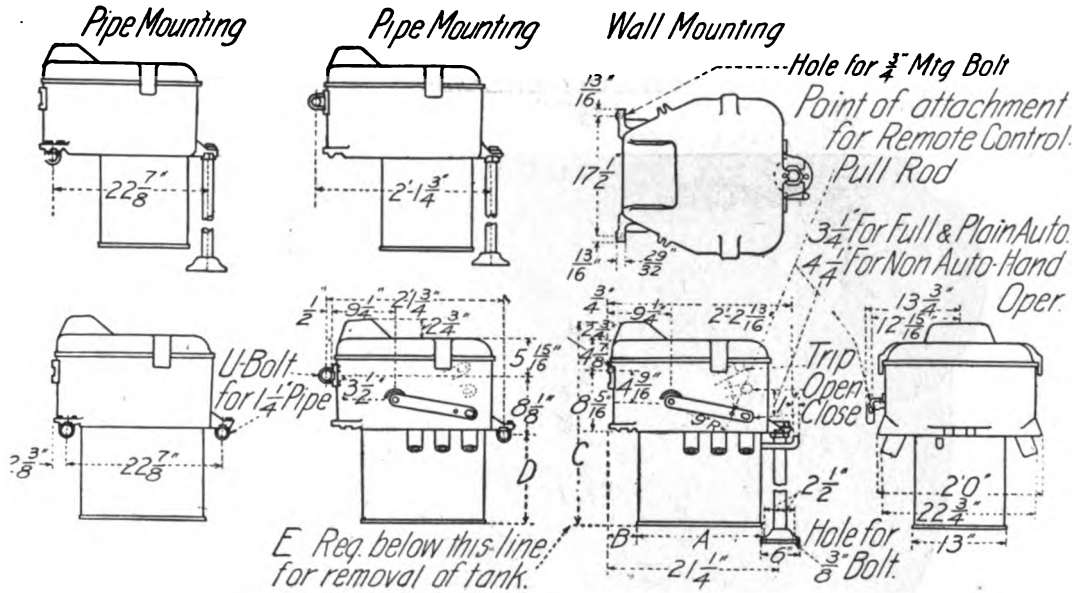


STYLE NOS. 205222 TO 205248 INCLUSIVE

These dimensions are for reference only. For official dimensions apply to the nearest district office.

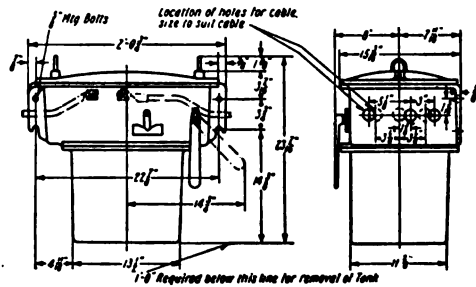
TYPE F OIL CIRCUIT-BREAKERS—Continued

TYPE F-3 WEATHERPROOF, SINGLE-THROW, OIL CIRCUIT-BREAKERS



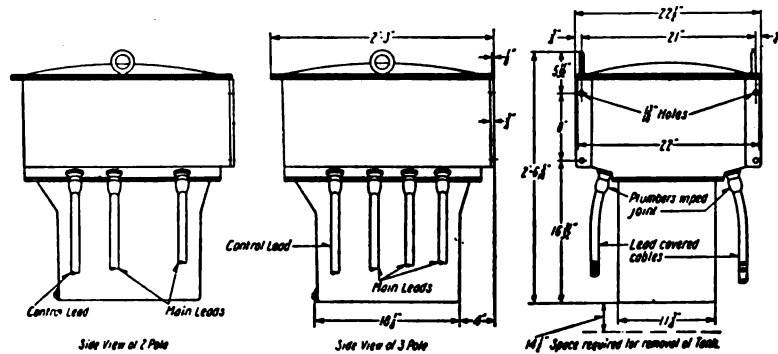
Style No.	DIMENSIONS IN INCHES				
	A	B	C	D	E
216901 to 216922	18 $\frac{3}{4}$	43 $\frac{1}{4}$	31	14 $\frac{1}{2}$	14 $\frac{1}{2}$
216923 to 216930	13	9 $\frac{1}{4}$	31	14 $\frac{1}{2}$	14 $\frac{1}{2}$
216931 to 216948	18 $\frac{3}{4}$	43 $\frac{1}{4}$	34	17 $\frac{1}{2}$	17 $\frac{1}{2}$
216949 and 216950	13	9 $\frac{1}{4}$	34	17 $\frac{1}{2}$	17 $\frac{1}{2}$

TYPE F-1 MANUALLY OPERATED, SINGLE-THROW, SUBWAY, OIL CIRCUIT-BREAKERS



STYLE NOS. 193579 TO 193590 INCLUSIVE

TYPE F-2 ELECTRICALLY OPERATED, SINGLE-THROW, SUBWAY, OIL CIRCUIT-BREAKERS



STYLE NOS. 216991 TO 217008 INCLUSIVE

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## MISCELLANEOUS BREAKERS

### TYPE M OIL-INSULATED MANHOLE CIRCUIT-BREAKERS

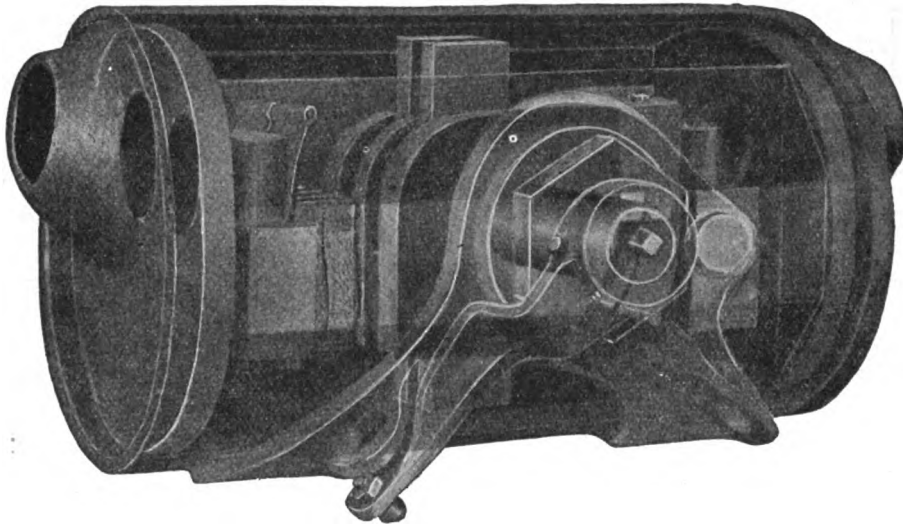


FIG. 1

Type M oil-insulated manhole circuit-breaker\* is a 200-ampere, 6600-volt, single-pole, single-throw, non-automatic circuit-breaker complete with loose ends, but without leads or padlock, and is covered by Style No. 305873. Figures 1 and 2 show the internal construction and general outline of the circuit-breaker, respectively.

The type M manhole circuit-breaker with an interrupting ability of 400 amperes at 6600 volts is designed for use in a manhole or underground chamber, as a means of readily opening a cable circuit. The circuit-breaker casing and end bells are constructed in such a manner that a lead cable sheath can readily be wiped on, the end bells being wiped to the casing after installation.

The circuit-breaker is filled with oil through a hole in the exposed end of the operating shaft. If it becomes either necessary or desirable to inspect the circuit-breaker or renew the oil, the oil should be removed, the leads pulled out after breaking

the joints, and the complete circuit-breaker taken to the repair shop for inspection and replacement of parts. Another circuit-breaker is installed in place of the one removed, and the circuit is ready for use. This permits the workers to be in the manhole for a minimum length of time, and allows all work except making of joints to be done in the repair shop.

The circuit-breaker is supported from the wall of the manhole or underground chamber by means of mounting straps. Since it is non-automatic, its operation is entirely under the control of the individuals carrying keys to the padlock.

The circuit-breaker can be locked in either the closed (on) or open (off) position by means of a padlock (to be furnished by the user), the "eyes" in the saddle, and the operating lever.

Approximate shipping weight is 70 pounds. Price will be furnished on request.

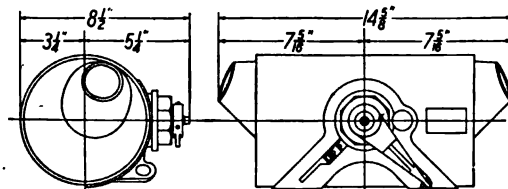
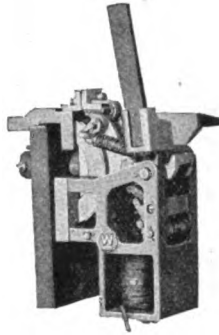


FIG. 2

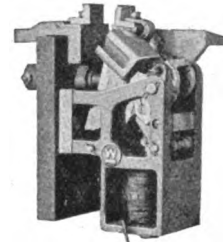


MISCELLANEOUS BREAKERS—Continued

TYPE JB MANHOLE CIRCUIT-BREAKERS



TYPE JB BREAKER CLOSED WITH HANDLE IN PLACE



TYPE JB BREAKER OPEN

The type JB manhole circuit-breaker was designed to isolate defective feeders in underground direct-current city distribution systems. The breaker is placed in a junction box under the street and is depended upon to trip whenever trouble develops in a feeder.

The breaker is a hand-operated air-break switch with a laminated brush form of contact. A trip coil is provided which will trip the breaker on voltages between 30 and 250.

The cable to be protected has an insulated pressure wire which replaces one of the strands of the outside layer of the cable. Should trouble develop

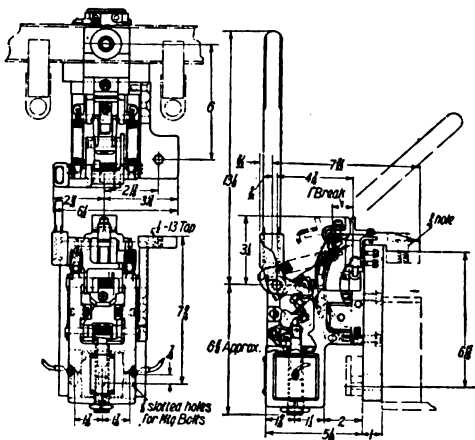
in the cable, the burning will ground this wire to the lead casing or cause it to become electrically connected to the strands of the cable. In either case the trip coil of the breaker is energized and the feeder is isolated for repair before the trouble spreads.

This type of protection has proved exceedingly valuable and has eliminated, wherever applied, disastrous cable blowouts.

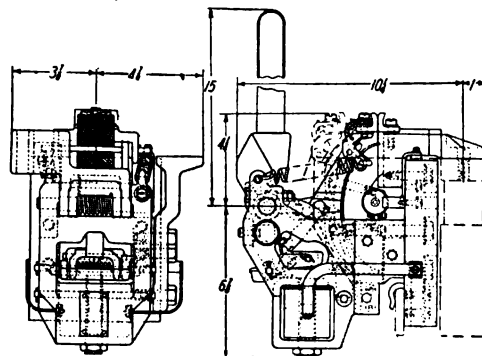
The breaker is available in two sizes, 1200 amperes and 2400 amperes at 250 volts.

Prices will be supplied on application.

Dimensions in Inches



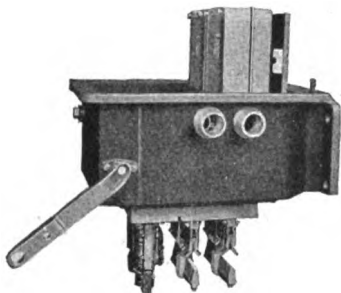
1200-AMPERE TYPE JB BREAKER



2400-AMPERE TYPE JB BREAKER

## MISCELLANEOUS BREAKERS—Continued

## SUBWAY TYPE F NETWORK OIL CIRCUIT-BREAKER



TYPE F SUBWAY BREAKER WITH TANK AND COVER REMOVED

Where alternating-current distribution is used in large cities the net work is coming more and more into use. The difficulties in this type of distribution are largely overcome by a secondary breaker which is arranged to disconnect the transformer from the network the instant the feedback endangers the service. By this means troubles in the transformers and high voltage circuits are isolated without any interruption of service.

This network protector is a self-contained unit consisting of a two-pole, 800-ampere, 600-volt oil breaker with two five-ampere trip coils equipped

with direct trip attachments. Contained within the box and mounted upon a Micarta panel are two type CR reverse power relays, calibrated from 4 to 16 amperes. The voltage coils of the relays are energized directly from the main studs and the current elements are energized from two bushing type current transformers. The current transformers also energize the trip coils and the direct trip attachments.

All of this equipment is self-contained within a cast iron box. The tank is of cast iron and bolts to the box with a lead gasket to make it watertight. The cover is of cast aluminum to facilitate its removal for inspection. It also bolts to the box and is equipped with a lead gasket for water proofing purposes.

The breaker has been remarkably successful. It is shipped from the factory completely wired, tested, and ready for operation.

Prices will be furnished on application.

## Dimensions in Inches

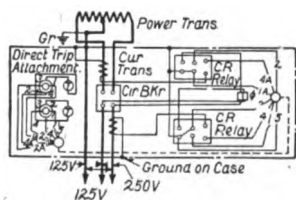
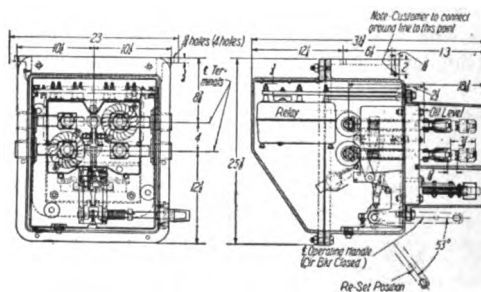
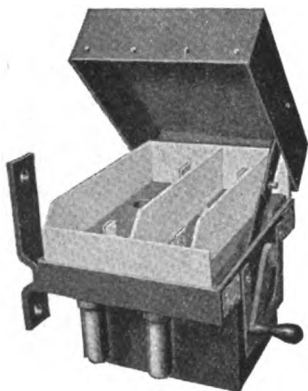


DIAGRAM OF CONNECTIONS

## TYPE M FUSED ENTRANCE SWITCH



The type M fused entrance switch is a single-throw, non-automatic, double-break, oil-immersed switch. In the top of the case provision is made for the mounting of 100-ampere, 2500-volt power fuses.

The cover is interlocked with the operating handle so that it is impossible to remove the cover for refusing unless the switch is in the "off" position.

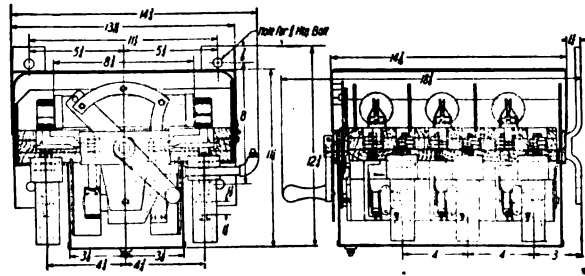
This switch is installed at the entrance of a power line into a customer's plant and provides protection against overloads and shorts in the plant and also makes it possible to disconnect the power when desirable.

The switch is available in two and three-pole sizes for 100 amperes, 2500 volts.

Prices will be furnished on application

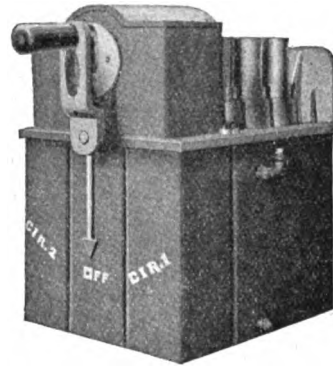
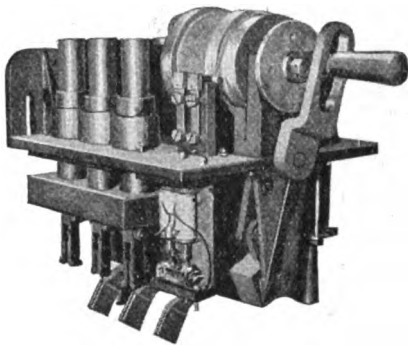
MISCELLANEOUS BREAKERS—Continued

Dimensions in Inches



TYPE M FUSED ENTRANCE SWITCH

TYPE M AUTOMATIC CHANGE-OVER SWITCH



The type M automatic change-over switch is a three-pole, double-throw, oil-immersed switch, rated at 100 amperes, 2500 volts. Its chief application is for hospitals, theatres and other locations where continuity of service is absolutely essential. Two sources of power are made available and the switch automatically transfers from one to the other source in case of failure of power on one of the sources. The energy for this transfer is supplied by a helical clock spring in which sufficient energy may be stored for about 25 transfers.

The transfer is actuated by the voltage conditions of the supply circuits through voltage transformers. Failure of voltage on circuit No. 1 de-energizes the relay coil and allows the moving member to drop, making a contact which energizes a trip coil. The trip coil releases the drum which rotates through 180 degrees and transfers the contact.

This is a thoroughly reliable device which guarantees the continuity of service, where continuity of service is imperative.

Prices will be furnished on application.

Dimensions in Inches

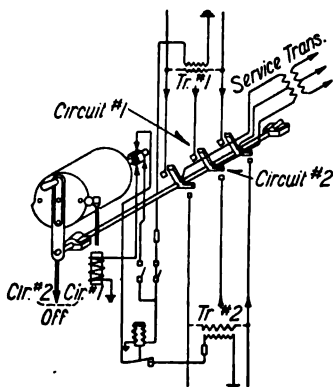
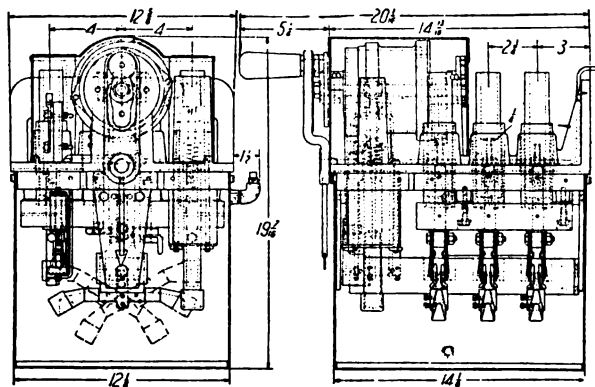
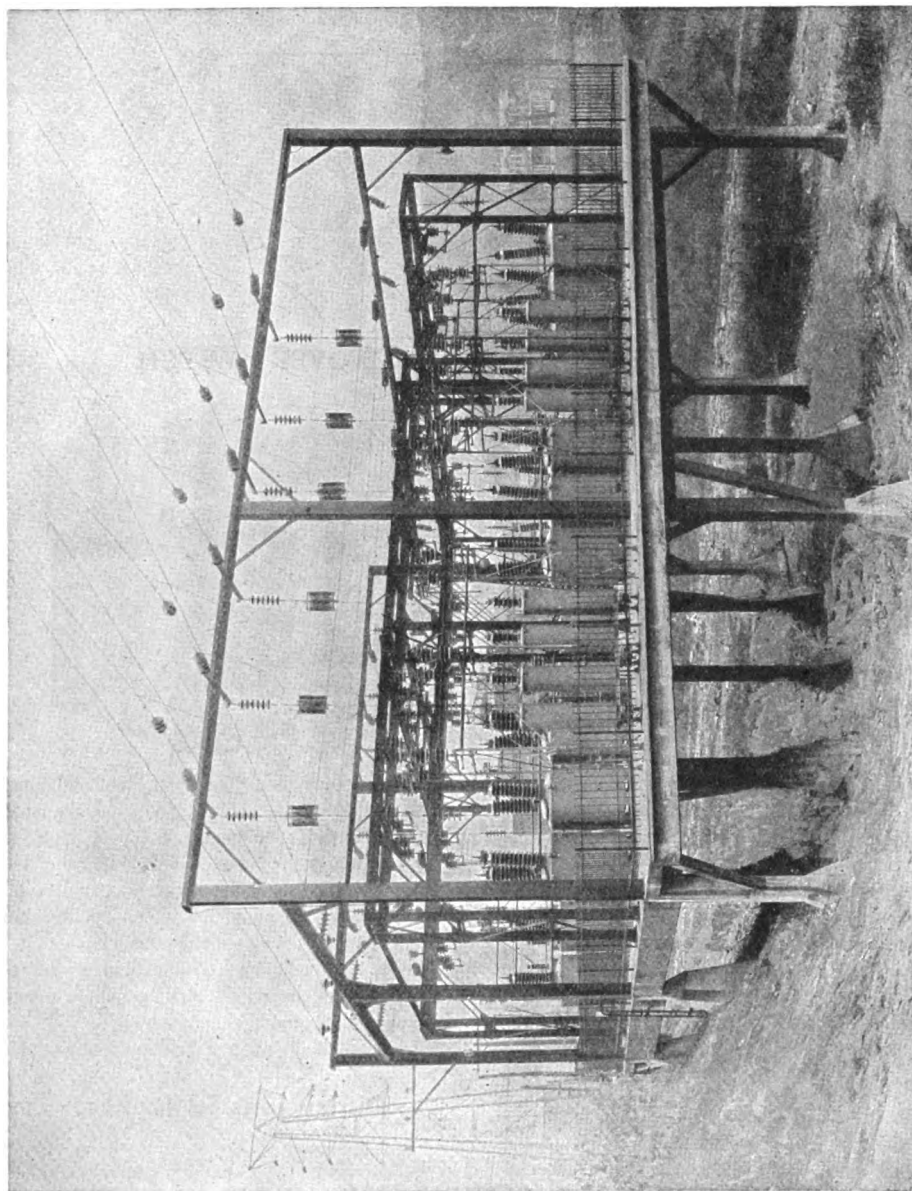


DIAGRAM OF CONNECTIONS SHOWING SWITCH IN OPEN POSITION





OUTDOOR SWITCHING STATION WITH: TYPE A1 LIGHTNING ARRESTERS, TYPE D-15 LINE SUSPENSION  
CHOKES COILS, TYPE G-2 ELECTRICALLY-OPERATED OIL CIRCUIT-BREAKERS

## LARGE OIL CIRCUIT-BREAKERS

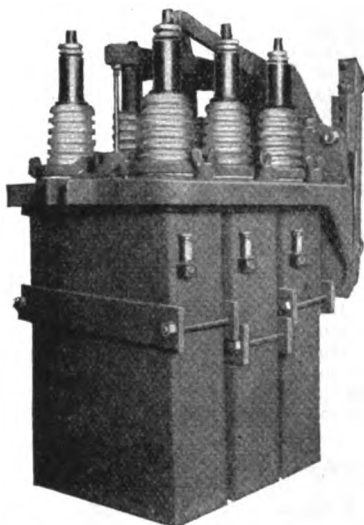
As a result of years of experience in the design and manufacture of switchgear for plants of the largest capacity and for transmission lines of high voltage, the Westinghouse Company has in addition to the moderate capacity circuit-breakers listed in detail, a complete line of larger capacity and higher

voltage oil circuit-breakers. A brief summary of the different types with their range of rated voltages, current capacities and rupturing capacities is given in the following pages. For complete information, prices, etc., apply to the nearest district office.

### TYPE B OIL CIRCUIT-BREAKERS

The type B oil circuit-breakers comprise a line of medium-capacity breakers.

They are built in five different forms, namely, type Ba, B-2, B-13, common frame, B-13 multiple, single-pole and B-4, each with a different interrupting capacity, maximum voltage, and details of construction.

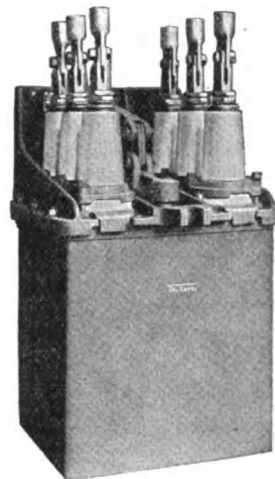


TYPE B-13 PIPE-MOUNTING THREE-POLE SINGLE-THROW 300-AMPERE 25,000-VOLT CIRCUIT-BREAKER

These breakers have a highly effective wiping and self-cleaning form of laminated brush contact, protected by liberally proportioned butt arcing contacts. The opening of all contacts occurs under oil, with a positive direct gravity break assisted by spring acceleration, and with open position maintained by gravity.

The tanks are of heavy sheet steel with all seams lap-welded. They are removable without disturbing the operating mechanism, making inspection of the contacts easy, and they are provided with a high grade insulating lining. The tanks are rectangular in shape except on the 1200-ampere and 2000-ampere type B-13, common frame, all the type B-13 multiple single-pole and all the type B-4 breakers, which have elliptical tanks similar to those on the type E breakers. The tank supports are very strong.

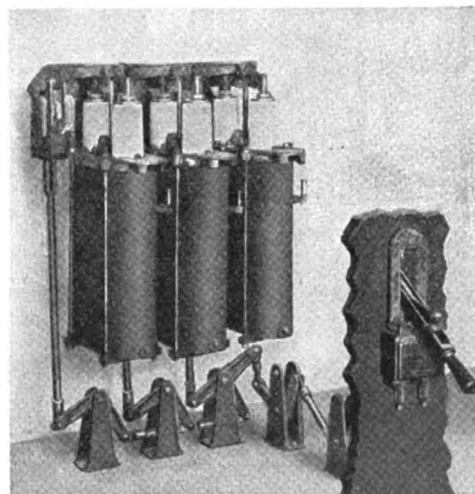
The type B circuit-breakers are common-frame circuit-breakers, except type B-13 which is also made in the multiple single-pole form. The type



TYPE B-2 PIPE-MOUNTING THREE-POLE SINGLE-THROW 600-AMPERE 15,000-VOLT CIRCUIT-BREAKER COMPLETE WITH TERMINALS

Ba has a tank per pole in all sizes. The type B-2 has a tank per pole in the 300-ampere and 600-ampere sizes, but a single tank construction in the other sizes. The types B-13 and B-4 have a tank per pole in all sizes.

Manually operated circuit-breakers are actuated by a handle mounted in the switchboard cover



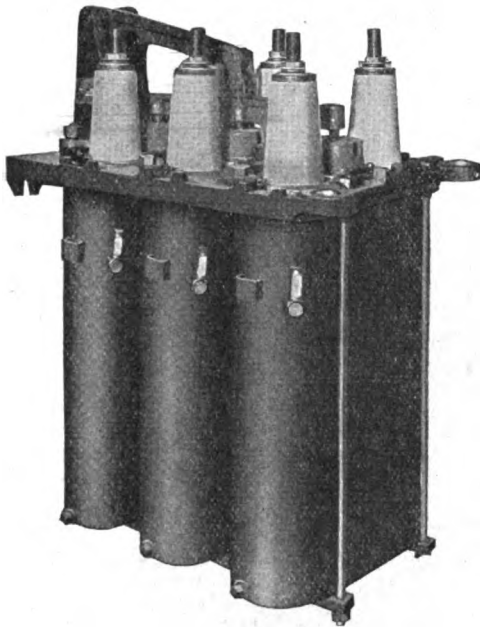
THREE-POLE TYPE B-13 MULTIPLE, SINGLE-POLE 600-AMPERE 15,000-VOLT MANUALLY OPERATED CIRCUIT-BREAKER

LARGE OIL CIRCUIT-BREAKERS—Continued

plate. When the breakers are supplied with automatic overload trip with remote control, an accelerating spring device is used to quicken the opening of the contacts, and this device, assisted by the arcing contact springs, gives to the moving parts an acceleration greater than that caused by gravity.

All of the following sizes of circuit-breakers can be supplied either manually or electrically-operated

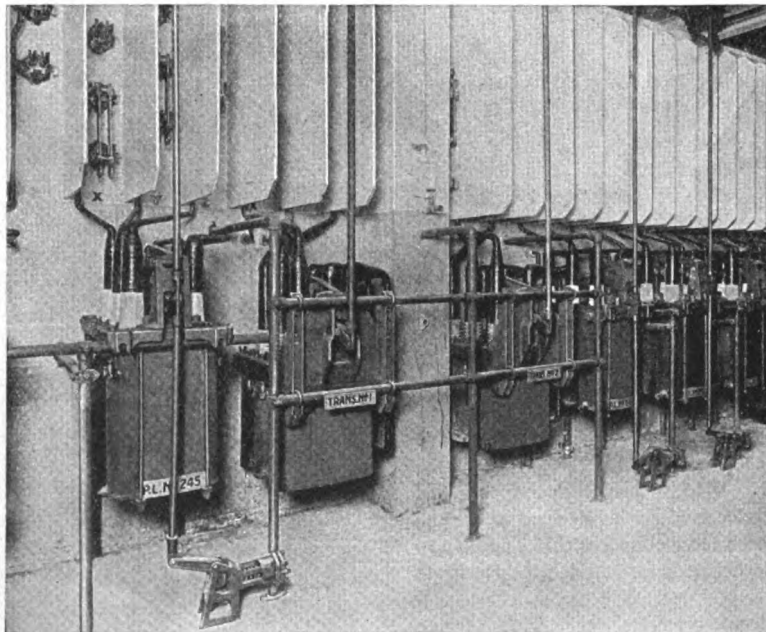
and either automatic with transformer-trip coils or non-automatic with the exception of the type B-4 and the type B-13 multiple single-pole breakers which are supplied remote control only. The manually-operated breakers can be panel-frame mounting, or remote-control, while the remote-control breakers, both hand and electrically-operated, can be furnished for wall mounting or pipe-frame mounting. All type B-a and type B-2 manually-operated breakers of 300 and 600 ampere capacities can be furnished panel mounting. All can be furnished in three pole, all except the type B-4 in two-pole, and all except the type B-4 and common frame type B-13 in four-pole frames.



TYPE B-4 THREE-POLE SINGLE-THROW 600-AMPERE, 15,000-VOLT OIL CIRCUIT-BREAKER

Type	MAXIMUM AMPERES		Maximum Volts	Interrupting Capacity in Arc Amperes at Rated Voltage†
	60-Cycle	25-Cycle		
Ba	300	400	15000	1080
Ba	600	750	7500	2800
B-2	300	400	15000	1520
B-2	300	400	25000	770
B-2	600	750	15000	1520
B-2	600	750	25000	770
B-2	1200	1350	15000	1520
B-2	1500	1600	7500	2400
B-2	2000	2250	7500	2400
B-13	300	400	25000	1300
B-13	600	750	25000	1300
B-13	1200	1350	15000	2720
B-13	2000	2250	7500	6240
B-13*	600	750	15000	2720
B-13*	1200	1350	15000	2720
B-13*	1600	1800	7500	6240
B-13*	2000	2250	4500	10950
B-4	600	750	15000	3600

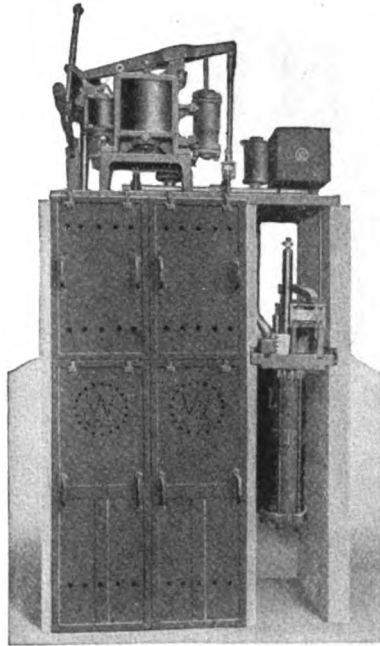
\*Multiple Single-Pole.  
†See footnote on page 268.



INSTALLATION OF REMOTE MANUALLY-OPERATED TYPES B-4 AND B-13 BREAKERS

## LARGE OIL CIRCUIT-BREAKERS—Continued

## TYPE E OIL CIRCUIT-BREAKERS



TYPE E-16 OIL CIRCUIT-BREAKER

The type E oil circuit-breakers are adapted to the control of alternating-current circuits of capacity up to 2000 amperes and voltages not over 25,000. They are designed for indoor mounting apart from the switchboard and for either manual or electrical control.

The following features particularly adapt the type E breakers to their class of service.

Very efficient self-cleaning form of high-pressure laminated brush main contacts protected by extra-heavy arcing contacts; submersion and opening of all contacts under oil; quick opening of contacts, assisted by heavy accelerating springs, open position maintained by gravity, strong elliptical lap-welded steel tanks and steel tank-supports; tanks removable without disturbing the operating mechanisms or contacts, making inspection easy; individual tanks enclose the contacts of each pole of the breaker; mufflers provided to allow for proper gas expansion and to prevent the throwing of oil; insulating linings in tanks, unit-type electrical operating mechanism having closing, tripping, accelerating, and shock absorbing features self-contained; manually-operated breakers tripped free of the mechanical remote control in the automatic

overload-trip forms; inability to hold full-automatic overload-trip forms of breaker in the closed position when an excessive overload or short circuit exists on the line; each pole a complete unit, operated by independently adjustable connecting rods to the common electric or manual-operating mechanism, and, in the cell mounting forms, installed in a separate masonry compartment.

The types E-16 and E-8 breakers are designed for cell mounting, and the types E-17 and E-9 for pipe-frame mounting.

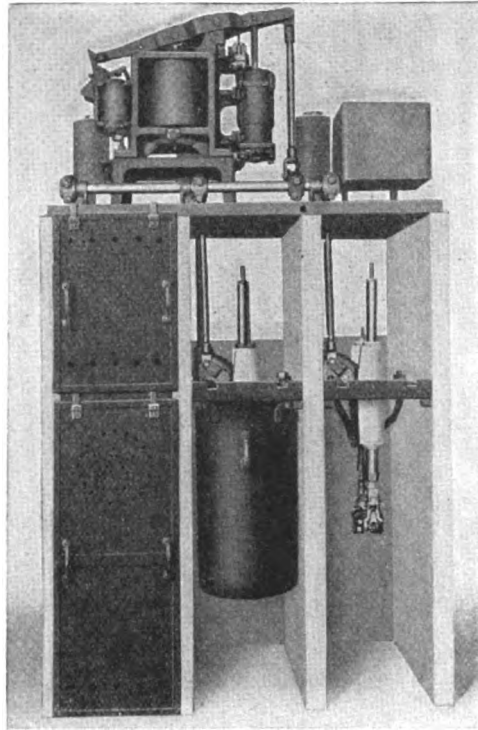
The following sizes are built in either two, three, or four-pole breakers, manually or electrically operated.

Type	MAXIMUM AMPERES		Maximum Volts	Interrupting Capacity in Arc Amps. at Rated Voltage†
	60-Cycle	25-Cycle		
E-16 & E-17	600	750	25000	4280
E-16 & E-17	1200	1350	25000	4280
E-16 & E-17	1600	1800	15000	8000
E-16 & E-17	2000	2250	15000	8000
E-8 & E-9	300	400	15000	3600
E-8 & E-9	300	400	25000	1760
E-8 & E-9	600	750	15000	3600
E-8 & E-9	600	750	25000	1760
E-8 & E-9	1200	1350	15000	3600
E-8 & E-9	1600	1800	7500	8240
E-8 & E-9	2000	2250	4500	14550

†See footnote on page 268.

## LARGE OIL CIRCUIT-BREAKERS—Continued

## TYPE OE OIL CIRCUIT-BREAKERS



TYPE OE-6 ELECTRICALLY-OPERATED OIL CIRCUIT-BREAKER

The type OE oil circuit-breakers are adapted to the control of large capacity circuits up to 2000 amperes and up to 15,000 volts. They are designed for indoor mounting apart from the switchboard, for either manual or electrical control and for cell or pipe-frame mounting. Where the growth of a system makes it advisable to replace type E-16 breakers with breakers of larger interrupting capacity, type OE-6 breakers with the same overall dimensions can be substituted by changing the thickness of the cell walls between poles.

The following features particularly adapt the type OE breakers to their class of service:

Very efficient and selfcleaning form of high pressure, parallel-path, laminated-brush main contacts.

Main contacts protected by extra heavy arcing contacts.

Permanent submersion and opening of all contacts under a large head of oil.

Quick opening of all contacts assisted by heavy accelerating springs.

Open position maintained by gravity.

Strong cylindrical diepressed steel tanks.

Tanks are not alive (they may be grounded).

Tanks removable without disturbing the operating mechanism or contacts, making inspection easy.

Individual tanks enclose contacts of each pole of the breaker.

Flame-resisting insulating linings in tanks.

Each tank equipped with a muffler which prevents throwing of oil.

Gases generated in breaker may be liberated outside of station.

Unit-type electrical operating mechanism with closing, tripping, accelerating, and shock absorbing features self-contained.

Manually-operated breakers trip-free of the mechanical remote control in the automatic overload trip form.

Inability to hold full automatic overload trip form of breaker in the closed position when an excessive overload or short circuit exists on the line.

Each pole a complete unit operated by independently adjustable connecting rods from the common electric or manual-operating mechanism and in the cell mounting breaker installed in a separate masonry compartment.

## Types OE-6 and OE-7 Oil Circuit-Breakers

MAXIMUM AMPERES	Maximum Voltage	Interrupting Capacity in Arc Amps. at rated Voltage†
600	15000	11200
1200	15000	11200
1600	15000	11200
2000	15000	11200

†See footnote on page 268.



## LARGE OIL CIRCUIT-BREAKERS—Continued

## TYPE O OIL CIRCUIT-BREAKERS

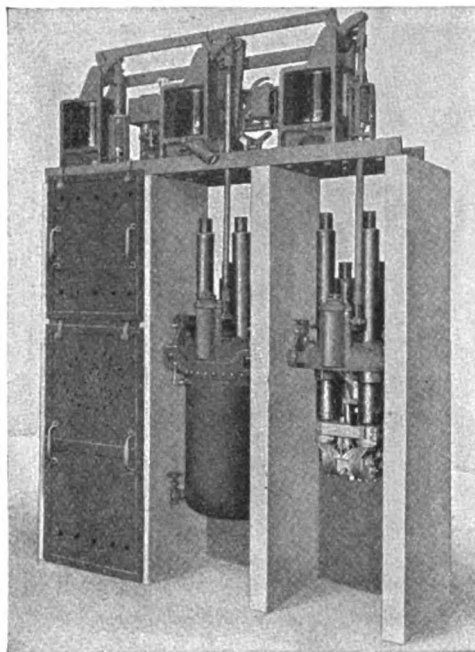
The type O oil circuit-breakers are adapted to the control of circuits of large capacity up to 4000 amperes where voltages do not exceed 25,000 volts.

This line supplements the type E and OE lines of cell mounting breakers, providing higher current and interrupting capacities. These breakers are supplied in single-pole unit form for cell mounting only, each pole being mounted in a separate masonry compartment. The operating mechanism is mounted on the top of the cell structure on a channel and plate base, and operates the several poles as a single unit.

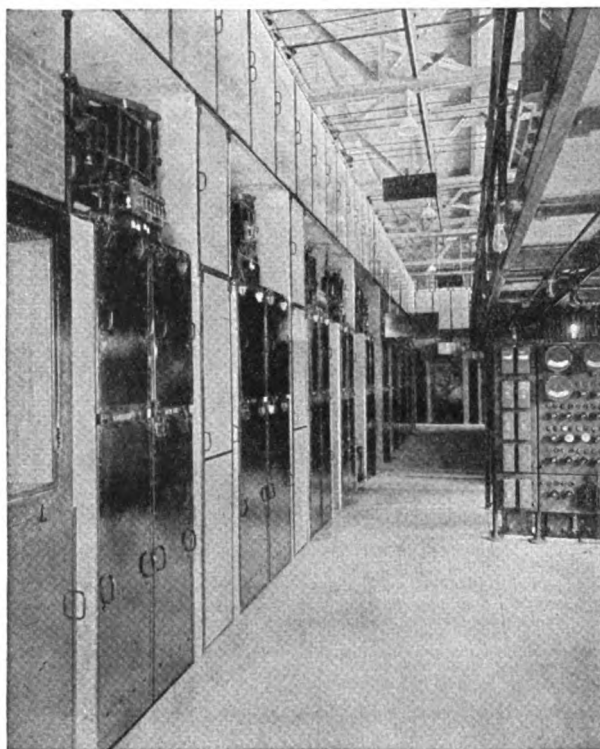
The tanks are cylindrical in form, seamless, and with rounded base, being die-pressed from heavy sheet steel. They represent the strongest form of tank construction possible. Type O-11 tanks are 16 inches in diameter, and types O-22 tanks 20 inches in diameter. These breakers are built in the following sizes, all cell mounting, electrically-operated only, in two, three, or four-pole forms.

Type	MAXIMUM AMPERES		Interrupting Capacity	
	60-Cycle	25-Cycle	Maximum Voltage	in Arc Amperes at Rated Voltage†
O-11	600	800	25000	8480
O-11	1200	1500	25000	8480
O-11	1600	2000	25000	8480
O-11	2000	2400	25000	8480
O-22	600	800	25000	12800
O-22	1200	1500	25000	12800
O-22	1600	20000	25000	12800
O-22	2000	2400	25000	12800
O-22	3000	4000	15000	24000
O-22	4000	5000	15000	24000

†See footnote on page 268.



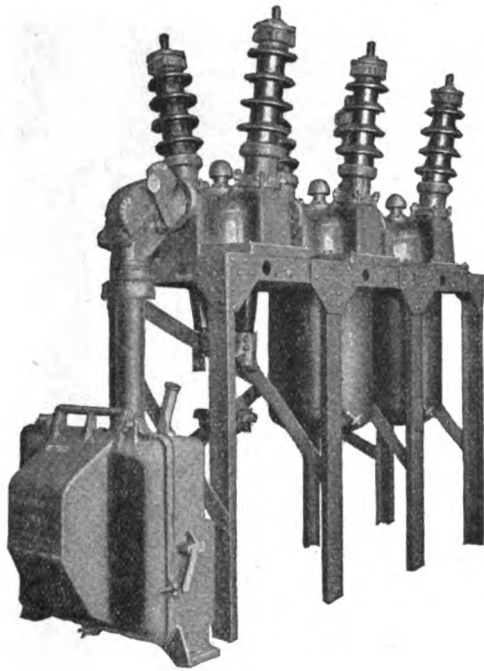
TYPE O-22 4000-AMPERE BREAKER, DOORS REMOVED



LARGE INSTALLATION OF TYPES E AND O BREAKERS

LARGE OIL CIRCUIT-BREAKERS—Continued

TYPE O-221 OIL CIRCUIT-BREAKERS



TYPE O-221 ELECTRICALLY-OPERATED OUTDOOR OIL CIRCUIT-BREAKERS

The type O-221 oil circuit-breakers are an adaptation of type O-22 breakers for frame mounting for either indoor or outdoor service. They are suitable for use on circuits having a maximum voltage of 37,000. The terminal bushings are of the condenser type, protected on the exposed part by porcelain rain shields for the outdoor breakers. The construction is similar to that of the type O-22 breakers, except that the terminal bushings enter the tank at an angle, to provide for a greater spacing between the exposed ends, and that the outdoor breakers have weather-proof details.

Type O-221 Oil Circuit-Breakers For Indoor and Outdoor Service

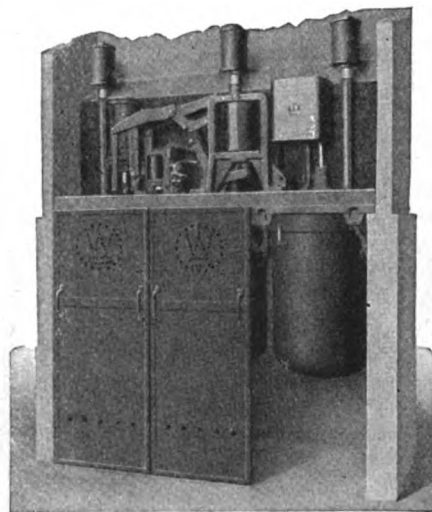
60 Cycles	MAXIMUM AMPERES		Maximum Voltage	Interrupting Capacity in Arc Amps. at Rated Voltage†
	25 Cycles	25 Cycles		
400	400	400	37000	7280
600	800	800	37000	7280
1200	1500	1500	37000	7280
400	400	400	25000	12800
600	800	800	25000	12800
1200	1500	1500	25000	12800
1600	2000	2000	25000	12800
2000	2400	2400	25000	12800

TYPE CO OIL CIRCUIT-BREAKERS

The type CO oil circuit-breakers in general perform on circuits of not over 25,000 volts the same service as the type O line, but in more compact space. They have a unit-type electric-operating mechanism, forming part of an entirely self-contained breaker which requires no intermediate walls in the cell structure for supporting individual poles. The complete breaker is shipped as one piece, except for the doors and barriers, with all adjustments of contacts and mechanism parts locked, thus reducing the installation work.

The following sizes are built only in three-pole, electrically operated, cell mounting form.

Type	MAXIMUM AMPERES		Maximum Volts	Interrupting Capacity in Arc Amps. at Rated Voltage†
	60-Cycle	25-Cycle		
CO-11	600	800	25000	8480
CO-11	1200	1500	25000	8480
CO-11	1600	2000	25000	8480
CO-11	2000	2400	25000	8480
CO-22	600	800	25000	12800
CO-22	1200	1500	25000	12800
CO-22	1600	2000	25000	12800
CO-22	2000	2400	25000	12800

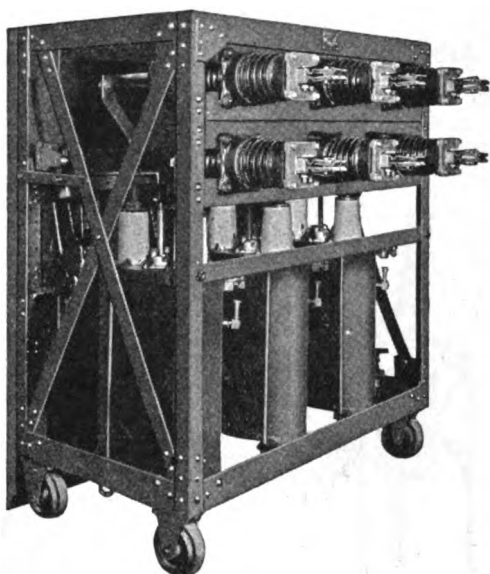


TYPE CO-22, 25,000-VOLT 2000-AMPERE CELL-MOUNTING BREAKER

†The new standard duty cycle on which these ratings are based, is as follows: Starting with the circuit-breaker in the open position, it may be closed against a short circuit, allowing it to open immediately, that is, without the intervention of a time limit device. This operation may be repeated at a time interval of not less than two minutes, after which the circuit-breaker shall be in substantially the same mechanical condition as at the start, and shall not have emitted flame. The circuit-breaker shall then be capable of carrying its rated current at rated frequency and voltage, but its operating ability may be substantially reduced.

## LARGE OIL CIRCUIT-BREAKERS—Continued

## TRUCK-MOUNTED OIL CIRCUIT-BREAKERS



TYPE B-13 MULTIPLE SINGLE-POLE, TRUCK-MOUNTED OIL CIRCUIT-BREAKER (REAR VIEW)

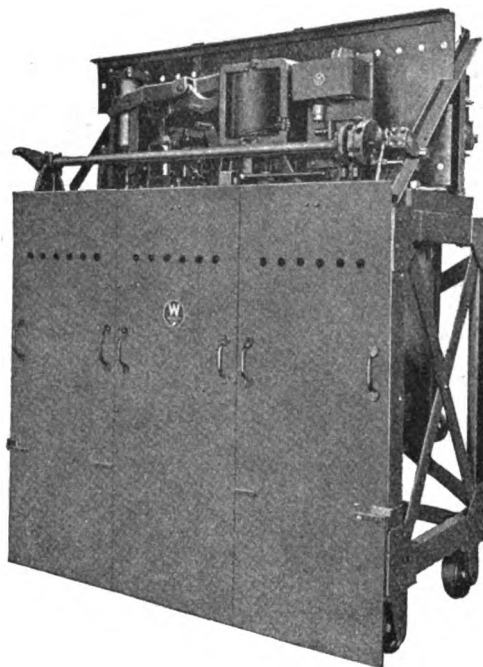
Truck-mounted breakers have been designed to meet application where minimum space requirements are of prime importance and where breakers of large interrupting capacity are required. All indoor breakers can be made truck mounting.

The special features of truck-mounted oil circuit-breakers are:

1. **Minimum Space Requirements**—Space requirements are considerably less than with other types of construction, resulting in lower building cost.

2. **Low Installation Cost**—Installation cost is low since the circuit-breaker mounted on the truck complete with disconnecting switch contacts, is shipped as a unit.

3. **Safety**—The interlocking device prevents the circuit-breaker truck from being removed from



TYPE CO-2 ELECTRICALLY-OPERATED TRUCK-MOUNTED OIL CIRCUIT-BREAKER (FRONT VIEW)

the compartment or inserted when the breaker is in the closed position. Also, the truck must be completely inserted in its compartment before the circuit-breaker can be closed.

4. **Ease of Maintenance and Making Repairs**—A complete truck unit is removed to the repair department where any repairs or adjustments can be made under the best conditions.

5. **Self-contained Disconnecting Switches.**

6. **Flexibility**—Where it is necessary to remove a circuit-breaker truck from its compartment for adjustment or repairs, a spare unit can be used in its place.

## TYPE G OIL CIRCUIT-BREAKERS

The type G oil circuit-breakers comprise a complete line of high-voltage breakers for indoor or outdoor use. Four forms of these breakers are built, known as types G-1, G-11, GA and G-2. Each form has a different interrupting capacity with corresponding differences in construction.

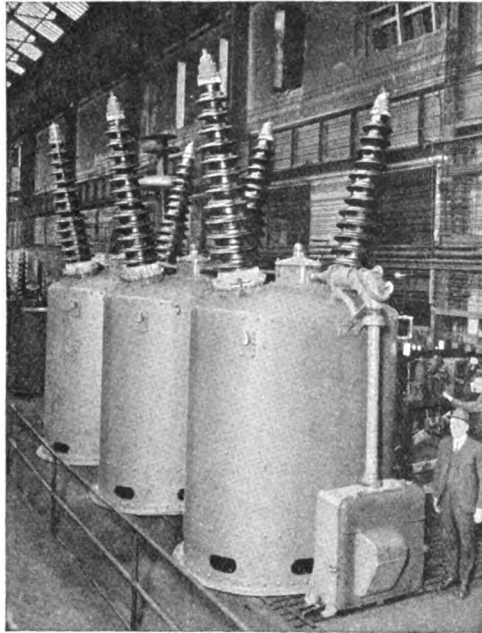
The type G breakers all have the well-known and highly satisfactory condenser type of terminal bushings, steel tanks with welded seams, and large expansion chamber with baffled vents for the arc gases.

All type G breakers can be had in automatic or non-automatic forms. Automatic overload trip-

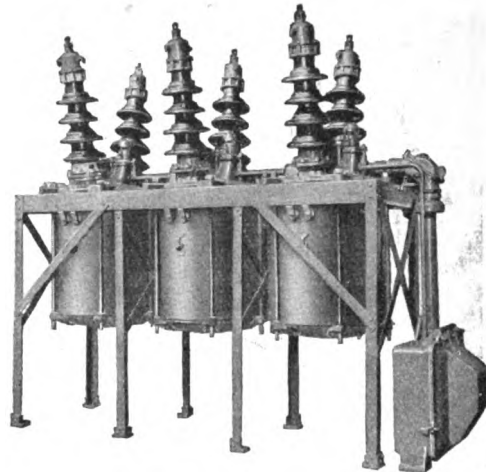
ping can be obtained either from separate current transformers or from bushing-type current transformers which are slipped over the breaker terminal bushings.

These breakers are available for all voltages from 7500 to 187,000, indoor or outdoor, manually or electrically-operated. They are available for frame mounting up to and including 73,000 volts. With interrupting capacities of from 1120 to 8240 arc amperes per phase at rated voltage available with different types, the requirements of present high voltage systems are well met with this line of breakers.

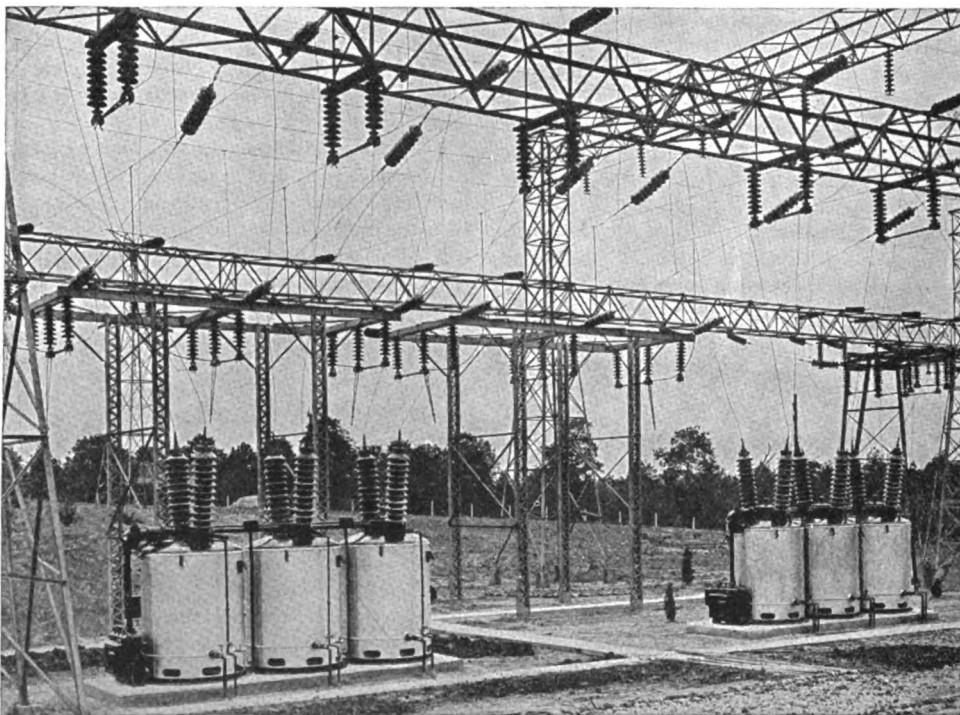
LARGE OIL CIRCUIT-BREAKERS—Continued



TYPE G-11 187,000-VOLT OUTDOOR OIL CIRCUIT-BREAKER



TYPE G-2 73,000-VOLT OUTDOOR FRAME-MOUNTED OIL CIRCUIT-BREAKER



TYPE G-2 110,000-VOLT OIL CIRCUIT-BREAKERS IN AN OUTDOOR SUB-STATION

2-506A

# WESTINGHOUSE SWITCHBOARDS

## GENERAL INFORMATION

Westinghouse switchboards can be obtained to meet any commercial demand that may arise in the control and application of electric current.

Standard panels using standard apparatus for various classes of service have been designed, and those of the smaller capacities, intended primarily for light and power systems of small industrial plants, public garages, small hotels, and central stations of small capacity are listed in this catalogue. These panels will be found to meet practically all ordinary requirements that may come up in switchboard installations. Drawings are available and a board made up of such panels can be shipped in less time and furnished at less cost than one having special panels, involving special drawings.

It is, therefore, of advantage for the customer to select standard panels whenever possible.

However, for special conditions that cannot be met by these standard panels, or where special material is desired, the extensive manufacturing facilities and long engineering experience of the Westinghouse Company insure that such propositions will be taken care of promptly and completely when referred to the Company with complete details of special requirements.

The selection of suitable switchboard apparatus for certain requirements is naturally governed by several conditions. In some cases first cost is the determining feature. In most cases continuity of service is of considerable importance. In many cases continuity of service must be provided regardless of cost. In all cases, the maximum degree of safety to life and property that can be obtained should be the goal. These, and other considerations, such as space available, voltage and capacity of plant, govern the proper selection of a switchboard equipment.

### Panel Materials

Black marine-finished slate has been adopted as the standard material for Westinghouse switchboards. Slate is one of the strongest and most serviceable materials known for this service, and where the voltage of live parts mounted on it does not exceed 750 volts, its insulating properties are entirely satisfactory. Where necessary for insulation on voltages above 750, the slate panels are provided with bushings for insulating the apparatus. Marble panels are furnished only on special order.

In appearance, black marine-finished slate is a dull velvety black which may easily be kept in good condition, and when rubbed with oil this finish will not show oil stains. This feature is of special importance where oil circuit-breakers are mounted directly on the panels.

When desired, other materials and finishes may be obtained on special order, involving an increase in price and a longer delivery.

### Finish

The standard black-marine finish is a durable finish of a dull velvety black appearance. It can readily be applied to switchboards in the field when the finish has been marred, or where the customer wishes to refinish an existing polished or black-enameled board. Other finishes than black marine can be obtained on special order, but in general, a longer delivery may be expected where such finishes are specified.

For the standard panels the finish of all metal parts on the front not carrying current is also black marine; current-carrying parts on the front of the panels are of polished copper or the equivalent of dipped finish.

Frames are painted black.

### Assembly and Connections

All Westinghouse panels for which frames are included and which have apparatus mounted directly on them, are completely assembled, with the exception of the meters and relays, and wired at the Works before shipment.

For remote-control boards all busses and connections are shipped in bulk uncut. For panel-mounted boards, if bus-bars and connections are of strap or rod, they are cut, bent and put in place; if they are of wire they are shipped on reels, uncut, together with the wire for instrument busses and for primary leads of voltage transformers.

The main connections for 600 volts and below are bare for all capacities. For higher voltages up to and including 3300, the main connections are of insulated wire up to 225 amperes. For larger capacities the main connections included in equipment style numbers are furnished bare, and must be insulated by the purchaser during installation if conditions so require. This insulation may consist of treated cloth tape or micarta tubing (refer to section on "Westinghouse Insulating Materials and Supplies").

The standard terminals, furnished on apparatus are suitable for the required size and number of cables per lead corresponding to the National Electrical Code rating of rubber-insulated cables for the particular ampere capacity. Ordinarily, standard terminals are larger than required due to the apparatus being used on circuits of less than the apparatus rating, or to the use of cable having other

## WESTINGHOUSE SWITCHBOARDS—Continued

insulation than rubber. Unless the customer advises the size of cables he will use, terminals will be supplied according to our understanding of his circuit requirements, or, if these cannot be judged, the terminals will be standard for the capacity of the apparatus.

A wiring diagram showing complete connections is supplied with each switchboard.

**Grounding Framework**—In general, the framework of switchboards for voltages above 150 volts should be effectively grounded except for d-c. grounded service (railway circuits), and for d-c. series circuits when the latter are provided with suitable rubber mats or wooden insulating platforms so that no person can inadvertently come in contact with such ungrounded parts while standing on any grounded surface (including floors of conducting materials). The grounding of non-current-carrying parts and the guarding of current-carrying parts is more important in those installations where unauthorized and untrained employees are liable to come in contact with the apparatus than in stations where only authorized and experienced employees are permitted.

Westinghouse switchboards are designed so that they may be installed in accordance with the regulations of the National Safety Code. However, where there are special local safety requirements, customers must call attention to them at the time of ordering switchboards, if provision is to be made for taking care of such requirements in the building of the switchboard.

To assist customers in complying with safety requirements the Westinghouse Company is prepared to furnish grillework enclosures of various patterns which will be found listed in Section 2-B of this catalogue.

### Instrument Equipment

The instruments regularly included in the panel equipment of Westinghouse switchboards are the standard Westinghouse apparatus and are of the highest grade. The meters supplied are the 7-inch round pattern instruments, except in the case of the smaller switchboards, where the 4 $\frac{3}{8}$  and 3 $\frac{1}{2}$ -inch round type meters are furnished.

### Field Rheostats and Field Switches

Field rheostats are operated by means of a hand wheel on the front of the panel, from which a shaft extends through the panel to the rheostat, or to a rotating mechanism for remote control. Rheostat mountings and controls are listed under "Switchboard Details". The handwheels are of black moulded material having a polished and permanent finish. The remote-control mechanisms are entirely enclosed in housings and the cable is led away through conduit positively preventing a broken cable from coming in contact with live conductors or parts on the switchboard.

In accordance with the most approved practice, field discharge switches are of the back-of-board

type with no live parts on the front of the switchboard.

Rheostat mountings are not included in the style number and list price of Westinghouse panels, but the generator and exciter panels are drilled for standard mounting.

If other than Westinghouse rheostats are to be provided for they must be remote controlled as the panels are not adapted for other than Westinghouse rheostats mounted directly on the rear of the panels. Drilling templates and necessary outline should accompany order.

### Ground Detector Outfits

Ungrounded systems should be equipped with some form of a ground detector for indicating grounded circuits. For systems up to and including 750 volts, a-c. or d-c., the ground detector consists of incandescent lamps capable of withstanding full bus-bar voltage connected in series from each bus-bar to ground. They are continuously indicating up to and including 300 volts, but above this voltage a push button is included in the circuit for safety reasons, which must be operated to obtain the indication.

Above 750 volts a continuously indicating ground detector of the electrostatic or glow type mounted on brackets on the top of the switchboard is used. It is not supplied as part of the standard generator panel equipment and must be ordered separately. Refer to type JB alternating-current switchboard panels in this section.

### Arrangement of Panels

The sequence of panels is important on account of the necessity for designing a switchboard to provide for future extensions, for the most economical distribution of bus-bar copper, and to provide means for measuring the total load.

When a switchboard comprises generator, totalizing, and feeder panels only, the standard arrangement of panels when facing the front of the switchboard is to place the generator panels at the left, the feeder panels on the right, and the load or instrument panels between the two.

In fixing any arrangement of panels it is most practical and economical to locate the heaviest capacity panels next to the totalizing panel, the lightest capacity panels being located at the ends. The bus-bar copper can then be tapered by the use of laminated bus-bars. This construction reduces the amount of bus-bar copper to a minimum and permits making extensions easily.

### Wall and Floor Braces

Panel and wall ends of wall braces are furnished for all type J switchboard installations, but the pipe (1 $\frac{1}{4}$  inch) for the braces is furnished only when the style number of the switchboard panel includes a pipe framework for mounting remote-control oil circuit-breakers. Braces are furnished with type K panel installations.

WESTINGHOUSE SWITCHBOARDS—Continued

**Erection Information**

Westinghouse switchboards and switching equipments are packed for shipment with unusual care. All of the detail apparatus is tagged or marked in such a manner that it may be readily identified when erecting. An instruction book covering approved methods for unpacking and erecting is furnished with each equipment.

**Capacity of Switchboard Apparatus**

The ampere rating of a switchboard panel corresponds to the capacity of the switches or circuit-breakers mounted on the panel or controlled from it. The switches and circuit-breakers listed on Westinghouse panels are rated in accordance with the National Electrical Code and will carry their rated amperage continuously.

Switches and circuit-breakers are given a maximum rating as they reach a final temperature quickly when carrying a steady current. Their capacity must therefore correspond to the one or two-hour overload capacity of the machine or circuit, if such a rating exists, in addition to its continuous capacity.

The usual temperature rise guarantee for switchboard apparatus when carrying its rated current is 28 degrees C. for knife switches, 30 degrees C. for conducting parts of carbon and oil circuit-breakers, and 50 degrees C. for circuit-breaker coils and frames. Bus-bars and connections are proportioned so as not to exceed 28 degrees C. rise and instrument transformers are not allowed to exceed 50 degrees C. Shunts and resistances are exempt from temperature limitations. A room-temperature of 25 degrees C. is used as a basis. Where the room-temperature exceeds this value, larger capacity apparatus should be chosen in order that the ultimate temperatures will not exceed those fixed on this basis.

The maximum possible setting of overload circuit-breakers should not be less than the momentary overload capacity of the machine or circuit.

Ammeters are commonly furnished with full scales corresponding to approximately 125 to 150 per cent of the ampere rating of the panel. This allows for overload swings and yet gives good readability on scale at normal load.

**Circuit-Breaker Calibration**

The tripping range of overload automatic circuit-breakers is from 80 to 160 per cent of their normal current rating.

**Fuses**

All fuses supplied on Westinghouse switchboards are Westinghouse enclosed fuses. They conform to the requirements of the National Electrical Code where it applies, and are included in the "List of Approved Fittings" issued by the National Board of Fire Underwriters.

Unless otherwise specified, fuses of the same capacity as the switches will be furnished. When desired, fuses of smaller capacity will be furnished according to the following list. The switch capacity must be the same as that of the fuse holder.

Fuse Holder	AMPERE RATINGS	
	250-Volt Fuses	600-Volt Fuses
30	6, 10, 15, 20, 25, 30	3, 5, 7, 10, 15, 20, 25, 30
60	40, 50, 60	40, 50, 60
100	70, 80, 100	70, 80, 100
200	125, 150, 175, 200	125, 150, 175, 200
400	225, 250, 275, 300, 350, 400	225, 250, 275, 300, 350, 400
600*	500, 600	500, 600

\*These capacities above 250 volts are not included in the National Electrical Code.

**Bus-Bars**

The amount of bus copper required for a switchboard equipment depends on the arrangement of panels and the distribution of circuits; hence, bus-bars are not included in the panel style numbers listed in this catalogue and must be ordered separately.

**Safe Carrying Capacity**—The amperes allowable per strap in the bus-bar will vary according to the conditions of installation and service.

The table below may be used as a guide in ordinary work. The values are based on 3/8-inch spacing between adjacent faces of straps, and on a temperature rise of not more than 28 degrees Centigrade above a room temperature of 25 degrees Centigrade. A reduction in the spacing between straps will decrease the amperes allowable per strap.

Maximum Continuous Bus Capacity Amperes	AMPERES PER COPPER STRAP 2" x 1/4" Strap	STRAP 3" x 1/4" Strap
500	400	600
1000	350	550
1500	...	500

For direct-current three-wire systems, include for third or neutral bus to rear of feeder panels, one strap of same size as other two busses. On rear of generator panels, when more than one generator panel is used, include for equalizer busses two busses each of capacity of largest generator.

For calculating the amount of copper needed for direct-current two-wire systems, the cross-section of the equalizer bus-bar is in general made about one-half that of the positive or negative bus behind the generator panels.

**Bus-Bar Prices**

When switchboard panels are for bus-bar operation the total list price of the switchboard is the list price of the panels with their equipment, selected from column headed "Bus-Bar Operation" in table of style numbers, plus a list price for bus-bar copper and insulators using the following unit prices:

Size of Strap Inches	List Price per Foot
2 x 1/4	\$1 25
3 x 1/4	1 75

## WESTINGHOUSE SWITCHBOARDS—Continued

## INSTRUCTIONS FOR ORDERING

Standard Westinghouse switchboard panels are described in the following pages of this section, and are listed by **Style Numbers**.

Standard panels should be ordered by these style numbers.

When a panel is ordered by style number, the purchaser will receive all of the apparatus included in that style number. The apparatus included is given in the following pages for each panel listed.

**Prices** not given herein will be furnished on application to the nearest district office.

When a panel or section is ordered by style number and no changes are to be made, no data sheet will be required. If, however, the panel is to be added to, or must match, an existing switchboard, or any other variations are required, the order must be accompanied by a switchboard **data sheet Form No. 2724**, completely filled out. If the data sheet does not seem to cover all of the purchaser's requirements and conditions, explanatory notes, sketches or drawings should also accompany the order to give complete information. Full information given at the time of entering the order prevents unnecessary correspondence and delay in shipment.

It is **urged that**, if possible, panels be selected from those listed, without alteration, as manufacturing information has been prepared on such panels and quick deliveries can be made. Panels covering a very wide range of application have, therefore, been listed so that any probable condition can be met by applying a standard panel.

The feeder panels listed may be adapted to control a smaller number of circuits than is included under the style number, in which case a deduction from the list price of the panel will be made for each feeder circuit omitted. The amount of this deduction is given in the following pages in connection with the various types of boards listed.

Panels forming part of a **multi-panel switchboard** requiring bus connections include all necessary bus-bar brackets, connections for operating the switchboard, etc., but **do not include the bus-bars**. Orders and requests for prices, therefore, should state whether the panels are "Panels for Individual Operation" or "Panels for Bus-Bar Operation."

**Additions to Switchboards**—All panels manufactured and assembled at the Works are supplied with a nameplate secured to the rear of the panels for identification and containing the following information:

1. Stock order number.
2. Number or position of panel.

These nameplates have been used since 1907 and this information should be furnished with the order when additions are to be made to Westinghouse switchboards. If it is known that changes have been made by the Purchaser since installation, the Company should be advised in regard to such changes if they have any bearing on the design of the new panel on order.

If panels are to be added and matched to switchboards not manufactured by this Company dimensioned drawings or sketches of the existing board should accompany order.

## Black-Dial Meters

**Will be Furnished if Desired at No Change in  
List Price**



## TYPE JD TWO-WIRE DIRECT-CURRENT SWITCHBOARD PANELS

110-220 VOLTS

**Application**—Type JD switchboards are particularly adapted to the control of from one to three generators in small industrial plants and central stations operating direct-current two-wire systems of 250 volts or less.

**Capacity**—The capacity of a single generator panel is limited to 600 amperes with fused knife switches and 800 amperes with type CL circuit-breakers, and that of a complete switchboard composed of these panels to 1800 amperes, with the number of panels limited to six. For greater capacities, a switchboard composed of type GD panels is recommended.

**Type Designation**—According to the usual method of designating types of panels, the letter J signifies that the panel is mounted on a type J  $1\frac{1}{4}$ -inch pipe frame, and the second letter D indicates direct-current application.

**Panel Construction**—Each panel consists of a single section, 48 inches high by 12, 16, 20, or 24 inches wide,  $1\frac{1}{4}$  inches thick, with  $\frac{1}{4}$ -inch bevels on front edges, bolted at the four corners to the switchboard frame. This frame is made of  $1\frac{1}{4}$ -inch pipe uprights, resting in floor flanges and supporting the necessary panel brackets, to which the panel is bolted. The total height of the panel is 76 inches.

**Automatic protection** is provided for the generator circuits by (a) single-pole type CL carbon circuit-breakers, or (b) enclosed fuse blocks mounted on the front of the panel; for feeder circuits by (a) single-pole type CL carbon circuit-breakers, (b) enclosed fuse blocks on the front of the panel, or (c)

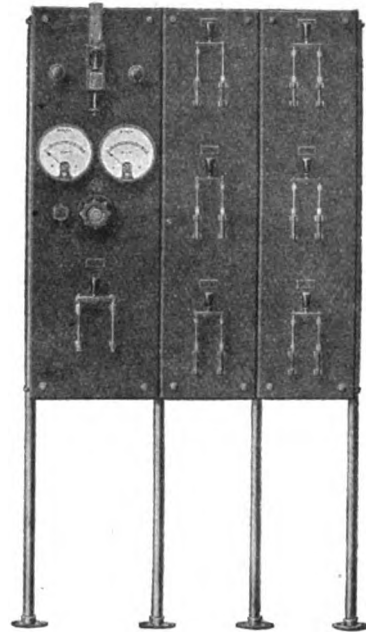


FIG. 1—TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS

enclosed fuse blocks on slate bases mounted on brackets on rear of panel.

**Field Rheostats**—Standard generator panels will be drilled for tetrapod rheostat mounting.

The panel style number does not include the rheostat mounting or the operating mechanism, but does include the necessary panel drilling to mount them.

**Data Sheet**—Each order for a switchboard should be accompanied by a switchboard data sheet, Form No. 2724, completely filled out. Full information given at the time of entering order prevents unnecessary correspondence and delay in shipment.

**Shipment**—Any one of the panels listed in this section can be shipped within 15 days after receipt of order at the factory with full and complete information and data sheet properly filled out. However, any change or substitution of apparatus as listed by style number will necessitate obtaining a new delivery promise from the Works.

Panel style numbers include the frame with wall brace ends, the panel with apparatus mounted thereon according to schedules given, and necessary details and connections for operating a single panel.

Bus-bars, when required, must be ordered separately. See also Instructions for Ordering.

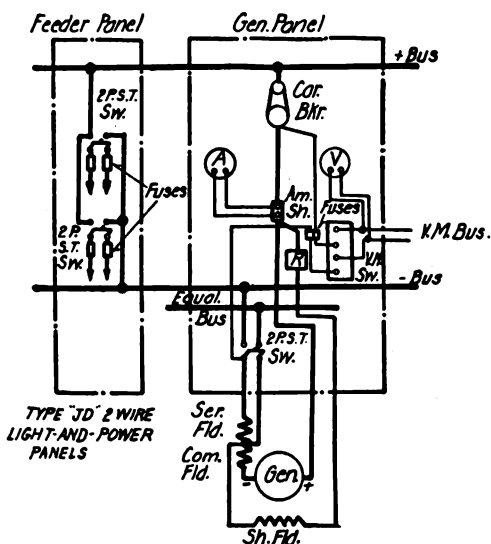


DIAGRAM OF TYPICAL CONNECTIONS

TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS—Continued

GENERATOR PANELS  
With Circuit-Breaker Protection

110-220 VOLTS

For a single-throw system order panel Fig. 2 for the first machine installed and panel Fig. 3 for each succeeding machine.

For a double-throw system order panel Fig. 4 for the first two machines installed and panel Fig. 5 for each succeeding machine.



FIG. 2



FIG. 3



FIG. 4

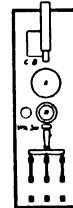


FIG. 5

Schedule of Apparatus

One ammeter, type SX.

\*One voltmeter, type SX.

One drilling only for standard Westinghouse tetrapod rheostat mounting.

\*One ground detector outfit.

One voltmeter switch, type RS, double-pole with a removable handle.\*

One circuit-breaker, type CL, single-pole.

One cardholder.

One knife switch, type A; two-pole for single-throw panels, three-pole for double-throw panels.

\*With panel Figs. 2 and 4 only.

Panel Width Inches	Fig.	AMPERE CAPACITY			PANEL STYLE No.		LIST PRICE			
		Switch	Circuit-Breaker	Ammeter Full Scale	110 Volts	220 Volts	110 VOLTS		220 VOLTS	
							Individual Operation	Bus-Bar Operation	Individual Operation	Bus-Bar Operation
<b>Single-Throw</b>										
16	2	30	25	50	333809	333818	\$230 00	\$235 00	\$232 00	\$237 00
16	2	60	50	100	333810	333819	235 00	240 00	237 00	242 00
16	2	100	100	200	333811	333820	240 00	245 00	242 00	247 00
16	2	200	150	200	333812	333821	245 00	250 00	247 00	252 00
16	2	200	200	300	333813	333822	250 00	255 00	252 00	257 00
16	2	400	300	500	333814	333823	255 00	265 00	257 00	267 00
16	2	400	400	600	333815	333824	295 00	305 00	297 00	307 00
20	2†	600	600	1000	333816	333825	335 00	345 00	337 00	347 00
20	2†	800	800	1200	333817	333826	370 00	380 00	372 00	382 00
16	3	30	25	50		333827	190 00	195 00	190 00	195 00
16	3	60	50	100		333828	195 00	200 00	195 00	200 00
16	3	100	100	200		333829	200 00	205 00	200 00	205 00
16	3	200	150	200		333830	205 00	210 00	205 00	210 00
16	3	200	200	300		333831	210 00	215 00	210 00	215 00
16	3	400	300	500		333832	215 00	225 00	215 00	225 00
16	3	400	400	600		333833	255 00	265 00	255 00	265 00
20	3†	600	600	1000		333834	295 00	305 00	295 00	305 00
20	3†	800	800	1200		333835	330 00	340 00	330 00	340 00
<b>Double-Throw</b>										
16	4	30	25	50	333836	333844	245 00	260 00	247 00	262 00
16	4	60	50	100	333837	333845	250 00	265 00	252 00	267 00
16	4	100	100	200	333838	333846	255 00	270 00	257 00	272 00
16	4	200	150	200	333839	333847	260 00	275 00	262 00	277 00
16	4	200	200	300	333840	333848	270 00	285 00	272 00	287 00
16	4	400	300	500	333841	333849	275 00	300 00	277 00	302 00
16	4	400	400	600	333842	333850	320 00	345 00	322 00	347 00
20	4†	600	600	1000	333843	333851	375 00	400 00	377 00	402 00
16	5	30	25	50		333852	205 00	220 00	205 00	220 00
16	5	60	50	100		333853	210 00	225 00	210 00	225 00
16	5	100	100	200		333854	215 00	230 00	215 00	230 00
16	5	200	150	200		333855	220 00	235 00	220 00	235 00
16	5	200	200	300		333856	230 00	255 00	230 00	255 00
16	5	400	300	500		333857	235 00	260 00	235 00	260 00
16	5	400	400	600		333858	280 00	305 00	280 00	305 00
20	5†	600	600	1000		333859	335 00	360 00	335 00	360 00

†These panels will not line up with other panels as meters, rheostats, and switches will be mounted lower down.

Approximate weight, boxed, 700 pounds.

Bus-bars and bus-connections are not included in the above style numbers.

Order by Style Number

TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS—Continued

GENERATOR PANELS

With Fuse Protection

110-220 VOLTS

For a single-throw system order panel Fig. 6 for the first machine installed and panel Fig. 7 for each succeeding machine.

For a double-throw system order two panels. Fig. 8 for the first two machines installed and panel Fig. 9 for each succeeding machine.



FIG. 6



FIG. 7



FIG. 8

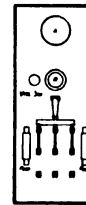


FIG. 9

Schedule of Apparatus

- One ammeter, type SX.
- \*One voltmeter, type SX.
- One drilling only for standard Westinghouse tetrapod rheostat mounting.
- \*One ground detector outfit.
- \*With panel Figs. 6 and 8 only.

- One voltmeter switch, type RS, double-pole, with a removable handle.\*
- One cardholder.
- One knife switch, type A, three-pole.
- Two fuse blocks and fuses, enclosed type.

Panel Width Inches	Fig.	AMPERE CAPACITY			PANEL STYLE No.		LIST PRICE			
		Switch	Fuse	Ammeter Full Scale	110 Volts	220 Volts	110 VOLTS		220 VOLTS	
							Individual Operation	Bus-Bar Operation	Individual Operation	Bus-Bar Operation
<b>Single-Throw</b>										
16	6	30	30	50	333860	333868	\$200 00	\$205 00	\$202 00	\$207 00
16	6	60	60	100	333861	333869	205 00	210 00	207 00	212 00
16	6	100	100	200	333862	333870	210 00	215 00	213 00	217 00
16	6	200	150	200	333863	333871	220 00	225 00	222 00	227 00
16	6	200	200	300	333864	333872	225 00	230 00	227 00	232 00
16	6	400	300	500	333865	333873	245 00	255 00	247 00	257 00
16	6	400	400	600	333866	333874	250 00	260 00	252 00	262 00
20	6	600	600	1000	333867	333875	290 00	300 00	292 00	302 00
16	7	30	30	50		333876	160 00	165 00	160 00	165 00
16	7	60	60	100		333877	165 00	170 00	165 00	170 00
16	7	100	100	200		333878	170 00	175 00	170 00	175 00
16	7	200	150	200		333879	180 00	185 00	180 00	185 00
16	7	200	200	300		333880	185 00	190 00	185 00	190 00
16	7	400	300	500		333881	205 00	215 00	205 00	215 00
16	7	400	400	600		333882	210 00	220 00	210 00	220 00
20	7	600	600	1000		333883	250 00	260 00	250 00	260 00
<b>Double-Throw</b>										
16	8	30	30	50	333884	333892	210 00	225 00	212 00	227 00
16	8	60	60	100	333885	333893	215 00	230 00	217 00	232 00
16	8	100	100	200	333886	333894	220 00	235 00	222 00	237 00
20	8	200	150	200	333887	333895	230 00	245 00	232 00	247 00
20	8	200	200	300	333888	333896	235 00	250 00	237 00	252 00
20	8	400	300	500	333889	333897	265 00	290 00	267 00	292 00
20	8	400	400	600	333890	333898	270 00	295 00	272 00	297 00
24	8	600	600	1000	333891	333899	310 00	335 00	312 00	337 00
16	9	30	30	50		333900	170 00	185 00	170 00	185 00
16	9	60	60	100		333901	175 00	190 00	175 00	190 00
16	9	100	100	200		333902	180 00	195 00	180 00	195 00
20	9	200	150	200		333903	190 00	205 00	190 00	205 00
20	9	200	200	300		333904	195 00	220 00	195 00	220 00
20	9	400	300	500		333905	225 00	250 00	225 00	250 00
20	9	400	400	600		333906	230 00	255 00	230 00	255 00
24	9	600	600	1000		333907	270 00	295 00	270 00	295 00

Approximate weight, boxed, 650 pounds.

Bus-bars and bus-connections are not included in the above style numbers.

Order by Style Number

TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS—Continued

ALTERATIONS FROM STANDARD FEEDER PANELS LISTED

The feeder panels listed may be adapted to control a smaller number of circuits than is included under the style number, in which case a deduction from the list price of the panel will be made for each feeder circuit omitted, according to the follow-

ing table. It should be noted, however, where switches are omitted from standard panels, that the space will remain blank, in order to maintain standard design and to permit of a possible future addition of the omitted circuit.

Ampere Capacity	DEDUCTIONS FROM PANEL LIST PRICE			
	Single-Throw Fuses on Front	Single-Throw Fuses on Rear	Double-Throw Fuses on Front	Double-Throw Fuses on Rear
30	\$5 00	\$10 50	\$8 75	\$12 00
60	8 00	12 50	10 00	14 00
100	12 50	19 50	14 50	21 50
200	18 50	22 00	22 00	24 00
300*	30 00	36 00	42 00	50 00
400	32 75	38 50	44 00	53 50

\*Capacity of switch is 400 amperes, fuses 300 amperes.

FEEDER PANELS

With Two-Pole Knife Switches and Single-Pole Circuit-Breakers  
110-220 VOLTS

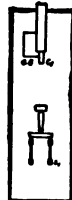


FIG. 10

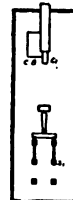


FIG. 11

Schedule of Apparatus

Per circuit—

- One knife switch, type A, two-pole.
- One circuit-breaker, type CL, single-pole.
- One cardholder.

Panel Width Inches	Number of Circuits Panel	Fig.	Throw of Switch	AMPERE CAPACITY AND DISTRIBUTION OF SWITCHES AND CIRCUIT-BREAKERS		Panel Style No.	LIST PRICE	
				S1	C1		Individual Operation	Bus-Bar Operation
12	1	10	Single	1-60	1-50	188020	\$115 00	\$130 00
12	1	10	Single	1-100	1-100	188021	120 00	135 00
12	1	10	Single	1-200	1-200	188022	130 00	145 00
12	1	10	Single	1-400	1-300	188023	150 00	165 00
12	1	10	Single	1-400	1-400	188024	190 00	205 00
12	1	11	Double	1-60	1-50	188025	120 00	140 00
12	1	11	Double	1-100	1-100	188026	125 00	145 00
12	1	11	Double	1-200	1-200	188027	140 00	160 00
12	1	11	Double	1-400	1-300	188028	170 00	190 00
12	1	11	Double	1-400	1-400	188029	210 00	230 00
20	2	10	Single	2-60	2-50	188030	170 00	190 00
20	2	10	Single	2-100	2-100	188031	150 00	200 00
20	2	10	Single	2-200	2-200	188032	190 00	210 00
20	2	10	Single	2-400	2-300	188033	230 00	250 00
20	2	10	Single	2-400	2-400	188034	295 00	320 00
20	2	11	Double	2-60	2-50	188035	180 00	210 00
20	2	11	Double	2-100	2-100	188036	190 00	220 00
20	2	11	Double	2-200	2-200	188037	210 00	240 00
20	2	11	Double	2-400	2-300	188038	270 00	300 00
20	2	11	Double	2-400	2-400	188039	335 00	365 00

Approximate weight, boxed, 400 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS—Continued

FEEDER PANELS

With Single-Throw Switches Fused on Front of Panel

110-220 VOLTS

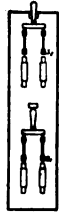


FIG. 12

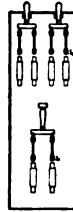


FIG. 13



FIG. 14

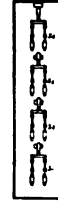


FIG. 15

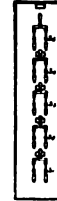


FIG. 16

Schedule of Apparatus

Fused knife switches, type A, 2-pole, single-throw.  
Cardholders, one for each switch.

Panel Width Inches	Number of Circuits Per Panel	Fig.	AMPERE CAPACITY OF FUSES AND DISTRIBUTION OF SWITCHES AND FUSES					Panel Style No.	LIST PRICE	
			S1	S2	S3	S4	S5		Individual Operation	Bus-Bar Operation
12	2	12	1-400	1-400	.....	.....	.....	187671	\$175 00	\$185 00
12	2	12	1-400	1-300*	.....	.....	.....	187672	170 00	180 00
12	2	12	1-400	1-200	.....	.....	.....	187673	180 00	170 00
12	2	12	1-300*	1-300*	.....	.....	.....	187674	165 00	175 00
12	2	12	1-300*	1-200	.....	.....	.....	187675	155 00	165 00
12	2	12	1-200	1-200	.....	.....	.....	187676	135 00	145 00
12	2	12	1-200	1-100	.....	.....	.....	187677	125 00	135 00
12	3	14	1-100	1-100	1-100	.....	.....	187678	140 00	150 00
12	3	14	1-100	1- 60	1- 60	.....	.....	187679	125 00	135 00
12	4	15	1- 60	1- 60	1- 60	1-60	.....	187680	140 00	150 00
12	10	16	2- 30	2- 30	2- 30	2-30	2-30	187681	185 00	200 00
16	3	13	1-400	2-200	.....	.....	.....	187682	185 00	200 00
16	3	13	1-400	2-100	.....	.....	.....	187683	175 00	190 00
16	3	13	1-300*	2-200	.....	.....	.....	187684	180 00	195 00
16	3	13	1-300*	2-100	.....	.....	.....	187685	170 00	185 00
16	4	12	2-200	2-200	.....	.....	.....	187686	185 00	200 00
16	4	12	2-200	2-100	.....	.....	.....	187687	175 00	190 00
16	6	14	2-100	2-100	2-100	.....	.....	187688	200 00	215 00
16	6	14	2-100	2- 60	2- 60	.....	.....	187689	180 00	195 00
16	8	15	2- 60	2- 60	2- 60	2-60	.....	187690	195 00	210 00
16	15	16	3- 30	3- 30	3- 30	3-30	3-30	187691	235 00	245 00
20	4	12	2-400	2-400	.....	.....	.....	187692	275 00	295 00
20	4	12	2-400	2-300*	.....	.....	.....	187693	270 00	290 00
20	4	12	2-400	2-200	.....	.....	.....	187694	245 00	265 00
20	4	12	2-300*	2-300*	.....	.....	.....	187695	270 00	290 00
20	4	12	2-300*	2-200	.....	.....	.....	187696	240 00	260 00
20	4	12	2-300*	2-100	.....	.....	.....	187697	225 00	245 00
20	4	12	2-200	2-200	.....	.....	.....	187698	190 00	210 00
20	4	12	2-200	2-100	.....	.....	.....	187699	180 00	200 00
24	9	14	3-100	3-100	3-100	.....	.....	187700	280 00	300 00
24	9	14	3-100	3- 60	3- 60	.....	.....	187701	235 00	255 00
24	12	15	3- 60	3- 60	3- 60	3-60	.....	187702	270 00	290 00
24	20	16	4- 30	4- 30	4- 30	4-30	4-30	187703	310 00	335 00

\*Capacity of switch is 400 amperes, fuses 300 amperes.

Approximate weight, boxed, 400 pounds.

Bus-bars and bus-connections are not included in the above style numbers.

Order by Style Number

TYPE JD DIRECT-CURRENT SWITCHBOARD PANELS—Continued

FEEDER PANELS

With Single-Throw Switches Fused on Rear of Panel

110-220 VOLTS

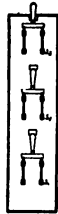


Fig. 17

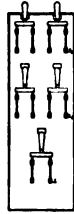


Fig. 18

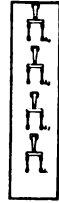


Fig. 19

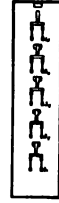


Fig. 20

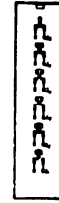


Fig. 21

Schedule of Apparatus

Knife switches, type A, two-pole, single-throw.  
 Fuse blocks and fuses, enclosed type, mounted on rear.  
 Cardholders, one for each switch.

Panel Width Inches	Number of Circuits Per Panel	Fig.	AMPERE CAPACITY OF FUSES AND DISTRIBUTION OF SWITCHES AND FUSES						Panel Style No.	LIST PRICE	
			S1	S2	S3	S4	S5	S6		Individual Operation	Bus-Bar Operation
12	3	17	1-400	1-400	1-400	.....	.....	.....	167704	\$275 00	\$290 00
12	3	17	1-400	1-300*	1-200	.....	.....	.....	167705	240 00	255 00
12	3	17	1-300*	1-300*	1-300*	.....	.....	.....	167706	270 00	285 00
12	3	17	1-300*	1-200	1-100	.....	.....	.....	167707	205 00	220 00
12	3	17	1-200	1-200	1-200	.....	.....	.....	167708	185 00	200 00
12	3	17	1-200	1-100	1-60	.....	.....	.....	167709	170 00	185 00
12	4	19	1-100	1-100	1-100	1-100	.....	.....	167710	195 00	210 00
12	4	19	1-100	1-100	1-60	1-60	.....	.....	167711	170 00	185 00
12	5	20	1-60	1-60	1-60	1-60	1-60	.....	167712	170 00	185 00
12	12	21	2-30	2-30	2-30	2-30	2-30	2-30	167713	210 00	230 00
16	5	18	1-400	2-200	2-200	.....	.....	.....	167714	295 00	315 00
16	5	18	1-400	2-200	2-100	.....	.....	.....	167715	280 00	300 00
16	5	18	1-400	2-100	2-100	.....	.....	.....	167716	265 00	285 00
16	5	18	1-300*	2-200	2-200	.....	.....	.....	167717	290 00	310 00
16	5	18	1-300*	2-200	2-100	.....	.....	.....	167718	275 00	295 00
16	5	18	1-300*	2-100	2-100	.....	.....	.....	167719	260 00	280 00
16	6	17	2-200	2-200	2-200	.....	.....	.....	167720	315 00	335 00
16	6	17	2-200	2-100	2-60	.....	.....	.....	167721	240 00	260 00
16	8	19	2-100	2-100	2-100	2-100	.....	.....	167722	305 00	325 00
16	8	19	2-100	2-100	2-60	2-60	.....	.....	167723	260 00	280 00
16	10	20	2-60	2-60	2-60	2-60	2-60	.....	167724	260 00	280 00
16	18	21	3-30	3-30	3-30	3-30	3-30	3-30	167725	320 00	345 00
20	6	17	2-400	2-400	2-400	.....	.....	.....	167726	480 00	505 00
20	6	17	2-400	2-300*	2-200	.....	.....	.....	167727	415 00	440 00
20	6	17	2-300*	2-300*	2-300*	.....	.....	.....	167728	470 00	495 00
20	6	17	2-300*	2-200	2-100	.....	.....	.....	167729	350 00	375 00
20	6	17	2-200	2-200	2-200	.....	.....	.....	167730	295 00	320 00
20	6	17	2-200	2-100	2-60	.....	.....	.....	167731	250 00	275 00
24	12	19	3-100	3-100	3-100	3-100	.....	.....	167732	480 00	505 00
24	12	19	3-100	3-100	3-60	3-60	.....	.....	167733	360 00	385 00
24	15	20	3-60	3-60	3-60	3-60	3-60	.....	167734	350 00	375 00
24	24	21	4-30	4-30	4-30	4-30	4-30	4-30	167735	430 00	460 00

\*Capacity of switch is 400 amperes, fuses 300 amperes.

Approximate weight, boxed, 400 pounds.  
 Bus-bars and bus-connections are not included in the above style numbers.

Order by Style Number

## TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

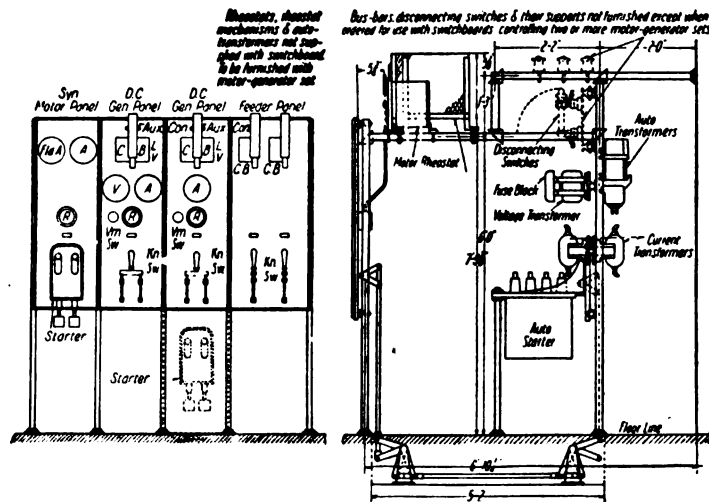


FIG. 1—TYPE JD SWITCHBOARD FOR MINES

As the negative side of the circuit is grounded, no ground detector outfit is supplied. The type RS voltmeter switch is single-pole, the negative side of the voltmeter being connected to ground.

Panels for the control of 600-volt engine-driven generators are similar to the 275-volt panels described above, except that 600-volt apparatus is supplied.

Panels for the control of direct-current generators which are part of motor-generator sets with overload protection in the motor circuit, have their connections modified in that the carbon circuit-breaker is single-pole and is placed in the positive side of the circuit. (See diagrams). The carbon breaker is electrically interlocked with the motor breaker so that it is tripped when the motor breaker trips.

When service-restoring contactors are used in place of carbon circuit-breakers, a single-pole knife switch is used in place of the two-pole switch.

Panels for the control of feeders are similar to the type JD two-wire feeder panels, except that a

single-pole knife switch is furnished in place of each two-pole switch, and the switches are for 600 volts for the 600-volt panels.

The switch is omitted when service-restoring contactors are used in place of carbon circuit-breakers.

Panels for the control of induction motors are furnished in the form of sub-panels for mounting directly below the direct-current generator panel.

Panels for the control of self-starting synchronous motors are furnished as separate switchboard panels to stand adjacent to the direct-current generator panel.

Panels for control of synchronous converters are arranged for starting the converter from the alternating-current end. The main panel contains the operating handle of the oil circuit-breaker for the high-tension side of the power transformers, and mounts the instruments and direct-current equipment with the exception of the field reversing switch. This field switch and the starting switch are arranged on a small separately mounted panel.

## SWITCHING EQUIPMENT AND AUTOMATIC PROTECTION

## For Motor-Generator Sets

The type QF motor-starting, oil circuit-breaker is double-throw; non-automatic for starting, and automatic with overload inverse-time-limit and low voltage release for running. The handles are interlocked so that the starting side must be closed first and so that the running side cannot be closed except within a fixed time interval after the starting side has been opened.

The starting position magnetizes the auto-transformers and connects the motor to the starting voltage, the tap leads of the transformer being permanently connected to the motor leads. In passing to the running position the auto-transformers are disconnected from the line and full-line voltage is applied to the motor.

## TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

The type QF motor-starting, oil circuit-breaker for three-phase service is four-pole double-throw with special moving contact arrangement. As listed with the motor panels, they are of two capacities, 300 amperes and 600 amperes.

As an alternative to the 300-ampere type QF motor-starting oil circuit-breaker a combination consisting of a three-pole, double-throw and a three-pole, single-throw, remote, mechanically-operated, type F-11 circuit-breaker can be supplied. One throw of the double-throw breaker constitutes the running breaker. It is overload automatic, with inverse time limit and low-voltage release mechanisms. The other throw of the double-throw breaker and the single-throw breaker constitute the starting units; the former magnetizes the auto-transformers and the latter connects the motor to the starting taps on the auto-transformers. The equipment is operated from a two handle cover-plate with interlocks between the two handles as described above. This combination is applicable for starting with either two single-phase auto-transformers or a three-phase auto-transformer.

The switching equipment for motors of capacities exceeding the ratings of the type QF motor-starting, oil circuit-breakers are made up of either two or three single-throw breakers as follows:

(a) For motors of 800-ampere capacity or less the equipment consists of two three-pole, single-throw F-11 breakers, operating in tandem for starting, and one three-pole, single-throw F-22 breaker for running. This combination is suitable for starting with either two single-phase auto-transformers or a three-phase auto-transformer.

(b) For motors of more than 800-ampere capacity, the equipment consists of a special four-pole, single-throw F-2 breaker for starting and a three-pole single-throw B-2 breaker for running. This combination is applicable only for starting with two single-phase auto-transformers.

The sequence interlock between handles is provided to prevent the possibility of impressing full line voltage upon a motor while at rest, and to insure that the time elapsing between the opening of the starting handle and the closing of the running handle is not long enough for the motor to drop in speed.

The inverse-time-element feature is provided in connection with the overload trip on the circuit-breaker or auto-starter, so that the motor circuit will not be opened on momentary overloads, such as obtain when the switches are moved from the starting to the running position. The time in which the overload trip will operate is inversely proportional to the amount of overload, tripping being instantaneous in case of a short circuit.

The overload tripping range is from 80 to 160 per cent of the current rating of the current transformers included with the panel equipment.

All circuit-breaker equipments have a low-voltage trip which opens the running breaker when the

voltage has dropped to approximately one-half its normal value. This feature is included to disconnect the motor from the line in case of loss of power for an appreciable length of time, and to prevent the return of full voltage to the motor when it is at standstill, or nearly so. For voltages up to and including 550, the low-voltage coil with series resistance is connected directly to the line. For higher voltages, a voltage transformer with primary fuse blocks and fuses is included.

The handle of the running circuit-breaker is equipped with an auxiliary switch which serves to operate the low-voltage trip circuit of the direct-current generator breaker of the motor-generator set, when the alternating-current breaker opens. Where a service-restoring contactor is used, the auxiliary switch of the running circuit-breaker opens the circuit of the operating coil of the direct-current breaker when the alternating-current breaker opens.

If the direct-current generator of a motor-generator set operates in parallel with an independent source of direct-current power, the set will run inverted upon the interruption of the alternating-current power and hold up the alternating-current voltage. The independent source of direct-current power may be a motor-generator set (or a synchronous converter) supplied from a separate alternating-current source, a generator driven by a prime mover, or a battery. In order to prevent motoring from the direct-current bus-bars, and to disconnect the set, a reverse-current relay should be included with the direct-current panel equipment and so connected as to trip the alternating-current breaker upon current reversal. With the electrical interlock mentioned in the preceding paragraph the direct-current breaker or service-restoring contactor is tripped on the opening of the alternating-current breaker and the set is thus completely disconnected in case of alternating-current power interruption.

### For Synchronous Converters

The protection provided for synchronous converters is the same as described in the preceding four paragraphs except that the alternating-current breaker is instantaneous trip and as the converter is provided with an overspeed device, the direct-current carbon circuit-breaker is equipped with a low-voltage release, the coil of which is connected to the alternating-current circuit. This arrangement is made so that the operation of the overspeed device will open the alternating-current and direct-current breakers simultaneously. When a service-restoring contactor is used, it trips in the same manner as described under motor-generator sets.

Figures 2 and 3 respectively illustrate the simplified connections, including reverse-current relay, for protection of synchronous converters and motor-generator sets, using plain overload direct-current breakers with low-voltage releases.



TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

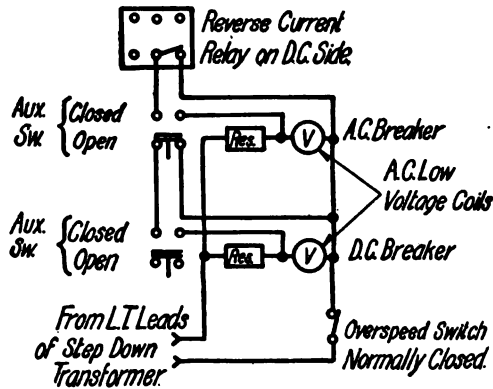


FIG. 2—SCHEME OF A-C-D-C. TRIPPING CIRCUITS FOR SYNCHRONOUS CONVERTERS WHEN STARTED FROM A-C. SIDE

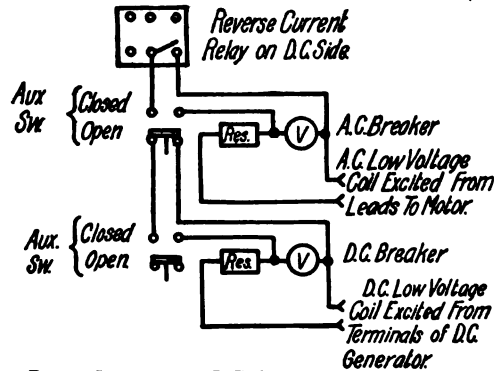


FIG. 3—SCHEME OF A-C-D-C. TRIPPING CIRCUITS FOR MOTOR-GENERATOR SETS WHEN STARTED FROM A-C. SIDE

CIRCUIT-BREAKER APPLICATIONS

The remote control circuit-breakers furnished with the standard equipments have interrupting capacity ratings as follows:

Type of Starter or Breaker	Normal Voltage Rating	Amps	INTERRUPTING CAPACITY AMPERES PER PHASE	
			750 Volts and Less	2500 Volts
QF	7500	300	15000	8600
QF	4500	600	25000	8600
F-11	2500	400	20000	6500
F-11	4500	200	10000	6500
F-22	2500	800	32000	9000
B-2	7500	1500	39000	11000

For Motor-Generator Sets

The short circuit amperes which the breaker may be called upon to interrupt must be considered in every case before applying the standard equipments. If the total capacity of generating and synchronous apparatus connected close to the motor is sufficient to deliver, under short circuit, a current in excess of the rated interrupting capacity of the running breaker included in the standard equipment, special consideration is necessary. Where the interrupting capacity required is more than the rating of the breaker in the standard equipment, it is necessary either to replace the running breaker by one of suitable interrupting capacity or supply a breaker of suitable interrupting capacity in series, which is set to open ahead of the running breaker of the standard equipment in case of a short circuit. The breaker at the power house may often serve this purpose where

the motor is supplied from a transmission line. In the latter case the breaker of the standard equipment must be given a definite minimum time delay by replacing the dash-pot inverse-time-limit attachment by direct-trip attachment and relay equipment giving a definite minimum time delay. It may be necessary also to use heavier duty starting breakers on a heavy capacity system.

It is important to note the conditions upon which the interrupting capacity ratings of circuit-breakers are based. A different inherent impedance in the generators, added impedance in step up and step down transformers and in transmission lines between the motor and the source of power and similar modified conditions, would make special consideration necessary. The matter of breaker application is fully covered in the section on "Oil Circuit-Breakers." Doubtful cases should be referred to the Company.

For Synchronous Converters

Due to the reliability obtained in the construction of power transformers, and the short length of leads between the high-tension oil circuit-breaker and the transformers, which reduces the possibility of a short circuit on the high-tension side to a minimum, oil circuit-breakers, which have sufficient interrupting ability to withstand any short circuits that might occur on the low-tension side of the power transformers, are furnished.

## TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

**Blank Sub-Panels and  
Channel Iron Base**

To meet the requirements of some operators for a switchboard with panels extending to the floor and supported on a channel iron base, the following optional equipment is listed. The sub-panel is 28 inches high, 1½ inches thick with the necessary

brackets for supporting it from the type J frame, and a channel iron (2 inches by 6 inches) base of the same width as the panel is included.

Width of Panel	Increase in List Price
16 inches .....	\$20 00
20 inches .....	22 50
24 inches .....	25 00

**SERVICE-RESTORING CONTACTORS**

Service-restoring contactors can be applied where it is desired to insure that circuits will not unnecessarily remain open when overload conditions have been removed. Power is automatically put back on the circuit as soon as conditions permit (except when purposely delayed by an adjustable time limit device), and the expensive delays due to failure of power is reduced to a minimum.

The service-restoring contactor is essentially a solenoid-operated breaker, the main contacts being held closed by the action of a solenoid.

When an overload or short circuit occurs on the load side of the line, the solenoid circuit is caused to open. This results in an immediate opening of the contactor which automatically restores service only after the overload or short circuit has been removed.

The service-restoring contactor equipments listed for motor-driven generator panels and synchronous converter panels are suitable for use with machines operating singly and connected to a single feeder which does not tie in with other stations. The service-restoring feeder panels listed are suitable for feeders which do not tie in with other stations.

When generators or converters operate in parallel or tie in with other stations, and when feeders tie in with other stations, a modified or different equipment is required. Requests for recommendations and quotations on such equipments should be referred to the Company.

The question of delivery for all panels equipped with service-restoring contactors should be referred to the Works.

**TYPE JD GENERATOR PANELS FOR MINES****1600 Amperes Maximum at 275 Volts; 800 Amperes Maximum at 600 Volts  
Direct-Current, Two-Wire, Grounded Negative**

For the control of one generator operating singly or in parallel

**Schedule of Apparatus**

One panel 48x16x1½ inches with type J frame, (panels for 1000 amperes and larger are 24 inches wide).

One ammeter, type SX.

\*One voltmeter, type SX.

One drilling only for standard Westinghouse rheostat mounting.

One voltmeter switch, type RS, single-pole with

removable handle (handle supplied only with style number panels including voltmeter).

One circuit-breaker, type CL, two-pole for engine-driven generators, single-pole for motor-driven generators. The breaker is equipped with a low-voltage release for use on panels controlling motor-driven generators.

One cardholder.

One knife switch, type A, two-pole, single-throw

\*Furnished only with panels as indicated in tables.

(Continued on next page)

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

TYPE JD GENERATOR PANELS FOR MINES—Continued

Volts	GENERATOR K. W. RATING			Panel Rating Amperes Continuous	WITH VOLTMETER			WITHOUT VOLTMETER		
	Contin-uous	25 per Cent Over-load	50 Per Cent Over-land		Panel Style No.	LIST PRICE		Panel Style No.	LIST PRICE	
						Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
<b>Engine-Driven Generators</b>										
275	28	22	19	100	333908	\$355 00	\$365 00	333918	\$310 00	\$320 00
275	41	33	28	150	333909	360 00	370 00	333919	315 00	325 00
275	55	44	38	200	333910	365 00	375 00	333920	320 00	330 00
275	83	66	55	300	333911	465 00	475 00	333921	420 00	430 00
275	110	88	73	400	333912	470 00	485 00	333922	425 00	440 00
275	165	132	110	600	333913	485 00	505 00	333923	440 00	455 00
275	225	188	150	800	333914	530 00	545 00	333924	485 00	500 00
275	275	220	200	1000	333915	670 00	685 00	333925	625 00	640 00
275	330	264	220	1200	333916	695 00	710 00	333926	650 00	665 00
275	440	352	300	1600	333917	745 00	765 00	333927	700 00	720 00
600	60	48	40	100	333928	360 00	370 00	333935	310 00	320 00
600	90	72	60	150	333929	365 00	375 00	333936	315 00	325 00
600	120	100	80	200	333930	370 00	380 00	333937	320 00	330 00
600	180	150	120	300	333931	470 00	480 00	333938	420 00	430 00
600	240	200	160	400	333932	475 00	490 00	333939	425 00	440 00
600	360	300	240	600	333933	490 00	505 00	333940	440 00	455 00
600	480	384	320	800	333934	535 00	550 00	333941	485 00	500 00
<b>Motor-Driven Generators</b>										
275	28	22	19	100	333942	305 00	315 00	333952	260 00	270 00
275	41	33	28	150	333943	310 00	320 00	333953	265 00	275 00
275	55	44	38	200	333944	315 00	325 00	333954	270 00	280 00
275	83	66	55	300	333945	400 00	410 00	333955	355 00	365 00
275	110	88	73	400	333946	405 00	420 00	333956	360 00	375 00
275	165	132	110	600	333947	420 00	435 00	333957	375 00	390 00
275	225	188	150	800	333948	455 00	470 00	333958	410 00	425 00
275	275	220	200	1000	333949	525 00	540 00	333959	480 00	495 00
275	330	264	220	1200	333950	545 00	560 00	333960	500 00	515 00
275	440	352	300	1600	333951	595 00	615 00	333961	550 00	570 00
600	60	48	40	100	333962	310 00	320 00	333969	260 00	270 00
600	90	72	60	150	333963	315 00	325 00	333970	265 00	275 00
600	120	100	80	200	333964	320 00	330 00	333971	270 00	280 00
600	180	150	120	300	333965	405 00	415 00	333972	355 00	365 00
600	240	200	160	400	333966	410 00	425 00	333973	360 00	375 00
600	360	300	240	600	333967	425 00	440 00	333974	375 00	390 00
600	480	384	320	800	333968	460 00	475 00	333975	410 00	425 00

MOTOR-DRIVEN GENERATORS WITH SERVICE-RESTORING CONTACTORS

1600 Amperes Maximum at 275 Volts; 800 Amperes Maximum at 600 Volts

Direct-Current, Two-Wire, Grounded Negative

For the control of one generator operating singly

Schedule of Apparatus

- One panel 48 x 24 x 1½ inches with type J frame.
- One ammeter, type SX.
- One voltmeter, type SX.
- One drilling only for standard Westinghouse rheostat mounting.
- One voltmeter switch, type RS, single-pole, with removable handle.
- One service-restoring contactor equipment.
- One cardholder
- One knife switch, type A, single-pole, single-throw.

Volts	GENERATOR K. W. RATING			Panel Rating Amperes Continuous	Panel Style No.	List Price
	Continuous	25 per cent Overload	50 per cent Overload			
275	28	22	19	100	333976	\$485 00
275	41	33	28	150	333977	495 00
275	55	44	38	200	333978	500 00
275	83	66	55	300	333979	525 00
275	110	88	73	400	333980	530 00
275	165	132	110	600	333981	545 00
275	225	188	150	800	333982	555 00
275	275	220	200	1000	333983	750 00
275	330	264	220	1200	333984	775 00
275	440	352	300	1600	333985	875 00
600	60	48	40	100	333986	530 00
600	90	72	60	150	333987	540 00
600	120	100	80	200	333988	545 00
600	180	150	120	300	333989	570 00
600	240	200	160	400	333990	575 00
600	360	300	240	600	333991	590 00
600	480	384	320	800	333992	600 00

Approximate weight, boxed, 600 pounds.

Order by Style Number

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

TYPE JC INDUCTION MOTOR PANELS

Maximum Horsepower 290 with 25 Per Cent Overload; 220, 440, 550, 2200 Volts; Three-Phase; 60 Cycles

For the control of induction motor, being part of a-c.—d-c. motor-generator set and started by two single-phase auto-transformers



FIG. 4

Schedule of Apparatus

One panel, 28x16x1½ inches, with necessary brackets for mounting as a sub-panel on type J frame.

One motor-starting, oil circuit-breaker equipment, type QF, of capacity as listed in table; remote-

control, manually-operated, pipe-mounted with bell-cranks mounted below floor, or upright in a trench below the floor level, and with sequence-starting interlock, inverse-time-element dash-pots and low-voltage release.

One pipe framework for mounting the circuit-breaker, current, voltage and \*auto-transformers.

Two current transformers of suitable ratio, type K.

One 2000-100 voltage transformer with fuses, for motor circuits above 550 volts, for use with the low-voltage coil of the type QF circuit-breaker.

For description of oil circuit-breaker equipment see "Switching Equipment and Automatic protection."

\*Auto-transformers are not included with these sections and must be ordered separately.

Volts	MOTOR		Amperes QF Starter	Ratings of Current Transformers	Panel Style No.	List Price
	*Hp. (with 25 Per Cent Overload)					
220	112		300	400-5	291355	\$590 00
220	225		600	750-5	291356	780 00
220	290		†	1000-5	291357	770 00
440	225		300	400-5	291358	595 00
440	290		600	500-5	291359	785 00
550	290		300	400-5	291360	600 00
2200	290		300	100-5	291361	640 00

Approximate weight, boxed, 600 pounds.

\*For motors of smaller capacity than listed order "same as Style No. .... except for .... Hp. motor." Refer to synchronous motor panel tables for difference in current transformer capacity.

†Three-breaker starter consisting of one 800-ampere, 3-pole, type F-22 breaker for running and two 400-ampere, 3-pole type F-11 breakers for starting.

Optional Equipment

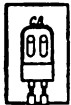


FIG. 5

The following type F-11 oil circuit-breaker combinations will be furnished, when desired, in place of the preceding style numbers as listed below:

One panel, 28 by 16 by 1½ inches, with necessary brackets for mounting as a sub-panel on type J frame.

One breaker equipment comprising one type F-11 breaker, 3 P. D. T. automatic on one throw, with low-voltage release, inverse-time-element, sequence

interlock and one non-automatic type F-11 breaker, 3 P. S. T., remote mechanically operated, pipe frame mounted.

One pipe framework for mounting the circuit-breaker equipment, current, voltage and †auto transformers.

Two current transformers of suitable ratio, type K.

One 2000-100 voltage transformer with fuses, for motor circuits above 550 volts.

Volts	MOTOR		AMPERES			Panel Style No.	List Price
	*Hp. (with 25 Per Cent Overload)	Ratio Current Transformer	CIRCUIT-BREAKER				
			3 P. D. T. F-11	3 P. S. T. F-11			
220	75	300-5	200	200	291362	\$520 00	
220	112	400-5	400	400	291363	590 00	
440	147	300-5	200	200	291364	525 00	
440	225	400-5	400	400	291365	595 00	
550	147	200-5	200	200	291366	530 00	
550	290	400-5	400	400	291367	600 00	
2200	290	100-5	200	200	291368	570 00	

Approximate weight, boxed, 600 pounds.

\*For motors of smaller capacity than listed order "same as Style No. .... except for .... Hp. motor." Refer to synchronous motor panel tables for difference in current transformer capacity.

†Auto-transformers not included and must be ordered separately.

Order by Style Number

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

TYPE JC SYNCHRONOUS MOTOR PANELS

Three-Phase, 60 Cycles

Remote-Control Pipe-Mounting, Maximum Hp. 433 with 50 Per Cent Overload, 220, 440, 550, 2200 Volts

For the control of a-c. self-starting, self-exciting synchronous motors, for standard Westinghouse a-c.—d-c. motor-generator sets started by two single-phase auto-transformers

Schedule of Apparatus

One panel 48 inches by 16 inches by 1½ inches, with type J frame.

One ammeter, type SY.

†One field ammeter, type SX.

One drilling only for Westinghouse remote control rheostat mounting.

One cardholder.

One oil circuit-breaker equipment manually operated, remote-control, pipe-mounted with bell-

cranks above floor as given in table below, with sequence-starting interlock, inverse-time-element dash-pots, and low-voltage release.

One pipe framework for mounting the auto-starter or circuit-breaker equipment, current, voltage and \*auto-transformers.

Two current transformers, type K up to and including 1000 amperes, type FB for 2000 amperes.

One 2000-100 voltage transformer with fuses, for motor circuits above 550.



FIG. 6

\*Not included in Style No. and must be ordered separately.

†Field ammeter capacities are suitable for use with standard Westinghouse motor-generator sets having 275-volt excitation.

PANELS WITH TYPE QF STARTING EQUIPMENTS

Volts	MOTOR H.P. RATING		AMPERES			Panel Style No.	List Price
	25 per cent Overload	*50 per cent Overload	QF Breaker	Main Ammeter	Cur. Trans. Primary (5 Amp. Secondary)		
220	75	...	300	250	200	333993†	\$760 00
220	...	75	300	300	300	333994‡	780 00
220	112	...	300	400	400	333995‡	780 00
220	150	112	600	500	500	333996	910 00
220	...	150	600	600	500	333997	910 00
220	225	...	600	750	750	333998	915 00
440	75	...	300	100	100	333999†	785 00
440	...	75	300	150	150	334000†	785 00
440	112	...	300	200	200	334001†	785 00
440	150	112	300	250	200	334002†	785 00
440	...	150	300	300	300	334003‡	770 00
440	225	...	300	400	400	334004‡	770 00
440	290	225	600	500	500	334005	915 00
440	...	290	600	600	500	334006	915 00
550	75	...	300	100	100	334007†	770 00
550	...	75	300	120	100	334008†	770 00
550	112	...	300	150	150	334009†	770 00
550	150	112	300	200	200	334010†	770 00
550	...	150	300	250	200	334011†	770 00
550	225	...	300	300	300	334012‡	775 00
550	290	225	300	400	400	334013‡	775 00
550	...	290	600	500	500	334014	920 00
550	433	433	600	750	750	334015	925 00
2200	75	...	300	25	25	334016†	810 00
2200	...	75	300	30	25	334017†	810 00
2200	112	...	300	40	50	334018†	815 00
2200	150	112	300	50	50	334019†	815 00
2200	...	150	300	60	50	334020†	815 00
2200	225	...	300	75	75	334021†	815 00
2200	290	225	300	100	100	334022†	820 00
2200	...	290	300	120	100	334023†	820 00
2200	433	433	300	200	200	334024†	820 00

\*Under conditions of excitation specified for the motors.

†The 200-ampere type F-11 remote-control, mechanically operated, oil circuit-breaker equipment as described under "Switching Equipment and Automatic Protection" may be substituted for the type QF, 300-ampere, remote-controlled breaker, when desired, at a reduction in list price of \$50.00.

‡The 400-ampere type F-11 remote-control, mechanically operated, oil circuit-breaker equipment as described under "Switching Equipment and Automatic Protection" may be substituted for the type QF 300-ampere remote-controlled breaker, when desired, at a reduction in list price of \$25.00.

PANELS WITH MULTI-BREAKER STARTING EQUIPMENTS

Volts	MOTOR H.P. RATING		AMPERES				Panel Style No.	List Price	
	25 per cent Overload	*50 per cent Overload	TYPE OF BREAKER		Main Ammeter	Cur. Trans. Primary (5 amp. Secondary)			
220	290	225	F-22	F-11	800	400	1000	334025	\$ 900 00
220	...	290	B-2	Special F-2	1200	500	1200	334026	1240 00
220	433	433	B-2	Special F-2	1500	500	2000	334027	1735 00
440	433	433	F-22	F-11	800	400	1000	334028	915 00

\*Under conditions of excitation specified for the motor.

Approximate weight, boxed, 800 pounds.

Order by Style Number

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

Optional Equipment

The following additional equipment can be furnished for type JD synchronous motor panels at an increase in the list price.

- One voltmeter, type SY.....\$55.00
- One power factor meter, type SY (one additional voltage transformer\* required for motor circuits above 550 volts).....\$75.00
- The type SX field ammeter can be omitted at a decrease in price when type SY power factor meter is added and a field ammeter is not desired. This allowance is \$40.00.
- One ammeter switch (for applications where it may be desirable to provide for reading the current in all phases).....\$12.00
- One reverse-current relay, type D (when required).....\$105.00
- One field discharge switch, 100-ampere, two-pole, double-throw, remote-control, mounted on rear of panel with operating handle on front (when required).....\$65.00

Standard panels have no field switches. A Westinghouse self-starting synchronous motor is started with the field circuit closed through the armature of its individual exciter if connected to the motor shaft; or if no exciter is provided and the motor is excited from the direct-current generator which it drives, the motor field is closed through the generator armature. The motor field is thus short-circuited at stand-still and is gradually excited as the motor comes up to speed.

\*Not included in list price, add from section 3-B on "Instruments and Relays."

A two-pole double-throw field switch must be supplied when the motor field is excited from a separate source of power, or from an exciter not connected to the motor shaft. When starting, the field switch is arranged to short-circuit the motor field until the motor has come up to synchronous speed. It is then closed to the normal position (motor field excited) before the motor is connected to full line voltage. The rheostat is in series with the field in the starting position as well as in the normal position of the field switch. Resistance for use with field-discharge switch is not included, as it is assumed to be part of the motor equipment.

Motor-generator sets for 275-volt direct-current service have the motor field excited across the direct-current generator terminals. Motor-generator sets for 600-volt direct-current service may have a separate 125-volt exciter connected to the same shaft, or the motor field may be excited from an exciter independent of the motor-generator set.

Where a separate exciter is used in connection with the motor field the panels are drilled for standard Westinghouse combination rheostat mounting, but the mounting is not included in the price of the panels. The panels are designed to have the exciter-field rheostat mounted on a tetrapod on the rear of the panels, with the motor-field rheostats separately mounted and operated by sprocket and chain. This mounting can be furnished at an addition to the price of the panel.

TYPE JC INCOMING LINE PANELS

Remote-Control—Pipe or Wall Mounting

300 Amperes, Max.—Three-Phase, 60-Cycle, 2200-Volt

The following panels match with the motor, generator, converter, and feeder panels listed for mine service, and control the power to the mine substation. These panels are desirable when more than one motor-generator set or converter are to be controlled, or when other equipments, such as pumps or fans are operated from the station bus.

Panels for other capacities and voltages than those listed can be furnished on special order.

Schedule of Apparatus

- One panel, 48x16x1½ inches, ¼-inch bevel.
- One ammeter, type SY.
- One cardholder.

\*One oil circuit-breaker, type F-11, three-pole, single-throw, remote-control, wall or pipe-mounted with cover plate mounted on panel.

One pipe framework for mounting the circuit-breaker and current transformers (for pipe-mounted breaker equipments only).

Two current transformers, type K.

\*The type F-11 oil circuit-breaker has an interrupting ability of 7300 amperes per phase at 2500 volts.

Amperes Max. Continuous	Ratings Current Transformers	WALL-MOUNTED BREAKER		PIPE-MOUNTED BREAKER	
		Panel Style No.	List Price	Panel Style No.	List Price
40	50-5	334028	\$335 00	334036	\$335 00
60	75-5	334030	340 00	334037	370 00
75	100-5	334031	345 00	334038	375 00
100	150-5	334032	350 00	334039	385 00
150	200-5	334033	355 00	334040	385 00
200	300-5	334034	360 00	334041	390 00
300	400-5	334035	365 00	334042	415 00

Approximate weight, boxed, 600 pounds.

Optional equipment—One type SY voltmeter can be furnished, if desired at an increase in list price of \$55.00. Add a voltage transformer and fuses except when used with a 2200-volt synchronous motor

panel which is provided with a voltage transformer. For list price, see section 3-B on "Instruments and Relays."

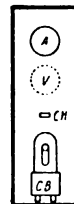


FIG. 7

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

SYNCHRONOUS-CONVERTER PANELS FOR MINE SERVICE

For the control of 275-volt, 6-phase, 60-cycle Synchronous Converters for mine service; 100, 150, 200 and 300-kw. with 50 per cent overload

Panels with Automatic Overload Carbon Circuit-Breakers

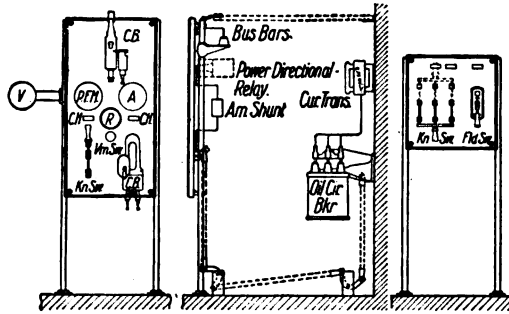


FIG. 8

FIG. 9

FIG. 10

Schedule of Apparatus

One panel 48x24x1½ inches, ¼-inch bevel, (Fig 8.)

One carbon circuit-breaker, type CL, with low-voltage release mechanism.

One ammeter, type SX, with shunt.

One power factor meter, type SY.

One drilling for standard Westinghouse remote control rheostat mounting.

One knife switch, type A, single-pole, single-throw, 250-volt.

One oil circuit-breaker equipment as listed; remote-control, manually operated, wall-mounted, bell-cranks above floor, with low-voltage release mechanism and hand reset.

One voltmeter switch, type RS, single-pole with removable handle.

One voltmeter, type SX, on swinging bracket, 300-volt scale.

Two cardholders.

Mounted Apart from Panel—

Two current transformers.

One starting panel (Fig. 10) 25x24x1½ inches, ¼-inch bevel, complete with pipe framework and braces to floor, and having mounted on it the following:

One knife switch, type A, three-pole, double-throw.

One field reversing and discharge switch, type A, two-pole, double-throw, 100-amperes, 250-volt, remote control, mounted on rear of panel with operating handle on the front.

Two cardholders.

One current transformer on rear for power factor meter.

Capacity K. W.	Line Voltage	Type Line Breaker	AMPERES				CURRENT TRANSFORMERS			Panel Style No.	LIST PRICE	
			Line Breaker	D-C. Circuit Breaker	D-C. Am- meter	Knife Switch	Starting Switch	For Line Breaker	For Power Factor Meter		Individual Operation	Bus-Bar Operation
100	440	F-11	200	600	800	600	200	300-5-K	300-5-K	334043	\$885 00	\$905 00
100	2200	F-11	200	600	800	600	200	50-5-K	300-5-K	*334044	895 00	915 00
100	6600	F-22	400	600	800	600	200	15-5-KR	300-5-K	334045	940 00	960 00
100	13200	BA	300	600	800	600	200	10-5-KB	300-5-K	334046	1125 00	1145 00
150	440	F-11	400	800	1200	800	400	400-5-K	400-5-K	334047	955 00	975 00
150	2200	F-11	200	800	1200	800	400	75-5-K	400-5-K	*334048	945 00	965 00
150	6600	F-22	400	800	1200	800	400	25-5-KR	400-5-K	334049	990 00	1010 00
150	13200	BA	300	800	1200	800	400	15-5-KB	400-5-K	334050	1175 00	1195 00
200	440	F-11	400	1200	1500	1000	600	500-5-K	500-5-K	334051	1010 00	1030 00
200	2200	F-11	200	1200	1500	1000	600	100-5-K	500-5-K	*334052	1000 00	1020 00
200	6600	F-22	400	1200	1500	1000	600	25-5-KR	500-5-K	334053	1050 00	1070 00
200	13200	BA	300	1200	1500	1000	600	15-5-KB	500-5-K	334054	1230 00	1250 00
300	440	F-22	600	1600	2500	1600	800	750-5-K	750-5-K	334055	1255 00	1275 00
300	2200	F-11	200	1600	2500	1600	800	150-5-K	750-5-K	*334056	1115 00	1135 00
300	6600	F-22	400	1600	2500	1600	800	50-5-KR	750-5-K	334057	1170 00	1190 00
300	13200	BA	300	1600	2500	1600	800	25-5-KB	750-5-K	334058	1350 00	1370 00

Approximate weight, boxed, 700 pounds.

\*These panels suitable for use, without change, when connected to a 4000-volt, 3-phase, 3-wire ungrounded neutral system. When connected to a 4000-volt, 3-phase, grounded neutral system, or 4000-volt, 3-phase, 4-wire system, an additional current transformer, for use with the line breaker, should be added.

Order by Style Number

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

Panels with Service-Restoring Contactors

For control of one synchronous converter operating singly.

Schedule of apparatus is the same as the preceding one except that the type A single-throw knife

switch is omitted and the carbon circuit-breaker is replaced by a service-restoring contactor equipment of suitable capacity. Capacity of other apparatus is the same as indicated in the preceding tabulation.

Cap. K.W.	Line Voltage	Panel Style No.	List Price Individual Operation	Cap. K.W.	Line Voltage	Panel Style No.	List Price Individual Operation
100	440	334059	\$970 00	200	440	334067	\$1245 00
100	2200	334060	980 00	200	2200	334068	1235 00
100	6600	334061	1025 00	200	6600	334069	1285 00
100	13200	334062	1210 00	200	13200	334070	1465 00
150	440	334063	1045 00	300	440	334071	1535 00
150	2200	334064	1035 00	300	2200	334072	1395 00
150	6600	334065	1080 00	300	6600	334073	1450 00
150	13200	334066	1265 00	300	13200	334074	1630 00

Approximate weight, boxed, 700 pounds.

Optional Equipment

When required, one reverse-current relay, type D, mounted on bracket on rear of panel, may be added at an increase in the list price of \$105.00.

When space is limited and the main panel is mounted adjacent to the transformers and converter, the starting panel, on special order, can be mounted as a sub-section beneath the main panel.

TYPE JD FEEDER PANELS FOR MINES

800 Amperes, Maximum, 275 to 600 Volts

DIRECT-CURRENT, GROUNDED NEGATIVE

Panels with Automatic Overload Carbon Circuit-Breakers

Schedule of Apparatus

One panel 48 inches by 1½ inches with ¼ inch bevels—width as per following table.

For each circuit:

One ammeter, type SX.

One carbon circuit breaker, type CL.

One knife switch, type A.

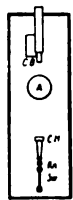


Fig. 11

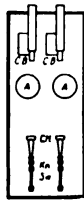


Fig. 12

CAPACITY IN AMPERES Panel and Breaker	Switch	Ammeter	Width Inches	275 VOLTS LIST PRICE			600 VOLTS LIST PRICE		
				Style No.	Individual Operation	Bus-Bar Operation	Style No.	Individual Operation	Bus-Bar Operation
<b>Single Circuit, Fig. 11</b>									
100	100	150	16	334075	\$205 00	\$220 00	334081	\$210 00	\$225 00
200	200	300	16	334076	210 00	225 00	334082	215 00	230 00
300	400	500	16	334077	260 00	275 00	334083	265 00	280 00
400	400	600	16	334078	265 00	280 00	334084	270 00	285 00
600	600	1000	16	334079	280 00	300 00	334085	285 00	305 00
800	800	1200	16	334080	310 00	330 00	334086	315 00	335 00
<b>Two Circuits, Fig. 12</b>									
100	100	150	16	334087	335 00	355 00	334093	340 00	360 00
200	200	300	16	334088	340 00	360 00	334094	345 00	365 00
300	400	500	16	334089	445 00	465 00	334095	450 00	470 00
400	400	600	16	334090	450 00	470 00	334096	455 00	475 00
600	600	1000	16	334091	485 00	510 00	334097	490 00	515 00
800	800	1200	16	334092	540 00	570 00	334098	545 00	575 00

Panels with Service-Restoring Contactors

These panels are similar to mine feeder panels with the plain automatic breakers, except that the circuit-breakers are replaced by service-restoring contactor equipment and the type A knife switches are omitted.

Amperes	Width Inches	Style No.	275 VOLTS LIST PRICE		Style No.	600 VOLTS LIST PRICE	
			Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
<b>Single Circuit</b>							
100	20	334099	\$360 00	\$375 00	334105	\$385 00	\$400 00
200	20	334100	370 00	385 00	334106	395 00	410 00
300	20	334101	390 00	405 00	334107	415 00	430 00
400	20	334102	400 00	415 00	334108	425 00	440 00
600	20	334103	415 00	435 00	334109	440 00	460 00
800	20	334104	430 00	450 00	334110	455 00	475 00
<b>Two Circuits</b>							
100	32	334111	630 00	650 00	334117	655 00	675 00
200	32	334112	655 00	675 00	334118	680 00	700 00
300	32	334113	695 00	715 00	334119	720 00	740 00
400	32	334114	700 00	720 00	334120	725 00	745 00
600	32	334115	750 00	775 00	334121	775 00	800 00
800	32	334116	775 00	805 00	334122	800 00	830 00

Optional Equipment—When ammeters are not required, they may be omitted at a reduction in the list price of \$40.00.

Approximate weights—Single circuit, boxed, 500 pounds; two circuits, boxed, 600 pounds.

Order by Style Number



TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

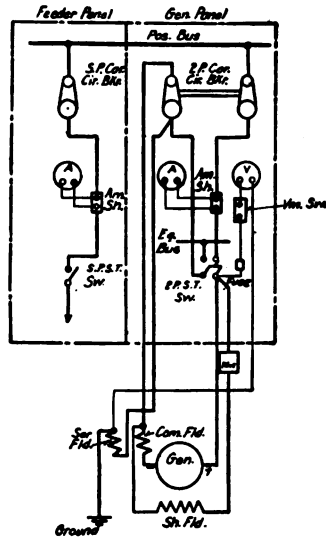


FIG. 13—MINE PANEL FOR ENGINE-DRIVEN GENERATOR

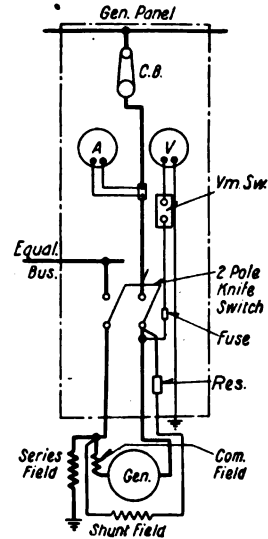


FIG. 14—MINE PANEL FOR MOTOR-DRIVEN GENERATOR (Circuit Breaker Interlocking Connections not shown)

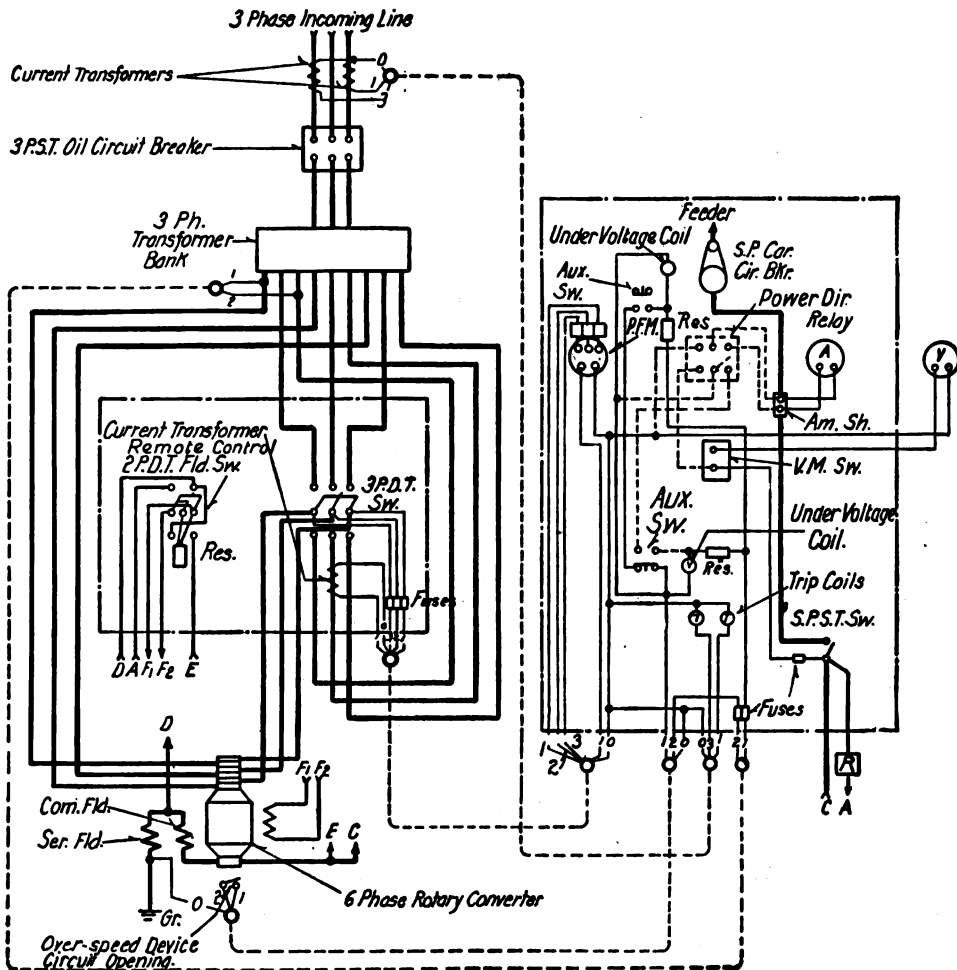


FIG. 15—CONNECTIONS FOR SYNCHRONOUS CONVERTER PANEL

TYPES JD AND JC SWITCHBOARDS FOR MINES—Continued

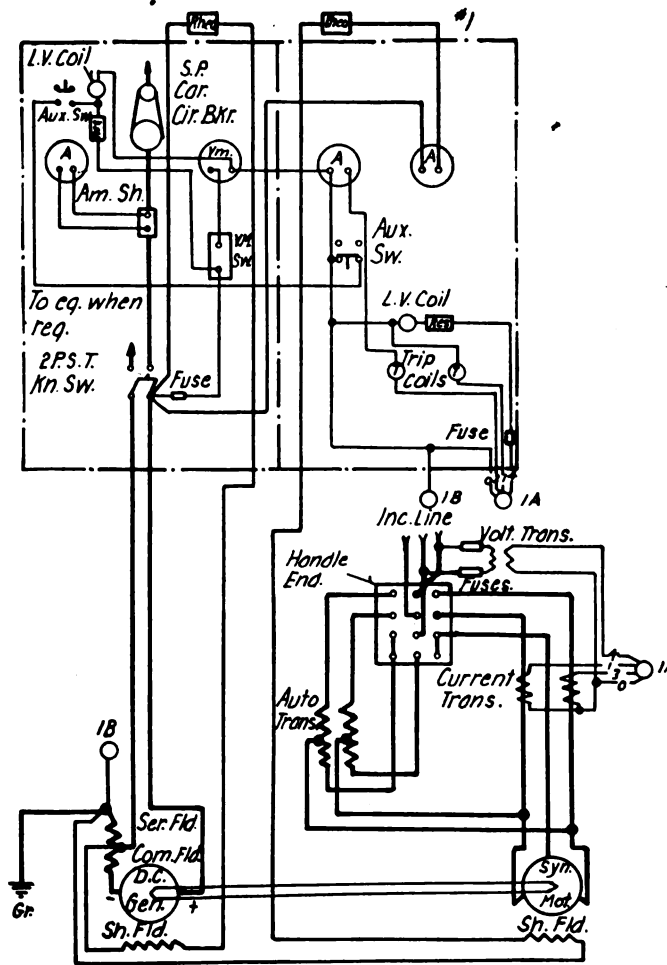


FIG. 16—CONNECTIONS FOR SYNCHRONOUS MOTOR, AND GENERATOR CIRCUITS

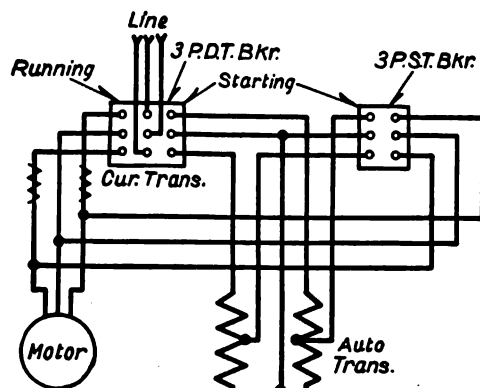


FIG. 17—DIAGRAM OF CONNECTIONS FOR TWO-BREAKER MOTOR-STARTING EQUIPMENT

## TYPE JD DIRECT-CURRENT COMBINATION GENERATOR-AND-FEEDER PANELS

110-220 VOLTS, TWO-WIRE

**Application**—Type JD combination panels are designed to provide a complete switchboard in a single panel for the control of one generator with four feeders. They are intended for use in isolated plants operating a single unit, direct-current, of 250 volts or less.

**Capacity**—The capacity of a panel is limited to 600 amperes for the generator and 200 amperes for each of the four feeders.

**Type Designation**—According to the usual method of designating types of panels, the letter J signifies that the panel is mounted on a type J 1 1/4-inch pipe frame, and the second letter D indicates direct-current application.

**Panel Construction**—Each panel consists of a single section, 48 inches high by 20 inches or 24 inches wide, 1 1/2 inches thick, with 1/4-inch bevels on front edges, bolted at the four corners to the switchboard frame. The total height of the panel is 76 inches.

**Automatic Protection**—Automatic protection is provided for the generator circuit by a single-pole type CL carbon circuit-breaker, or by enclosed fuses mounted on the front of the panel; for the feeder circuits, by enclosed fuses mounted on the front of the panel.

**Connections**—The main connections on the back of the panels are of bare copper strap and are cut, bent, and assembled before shipment.

**Shipment**—Any one of the panels of this type can be shipped within 15 days after receipt of order at

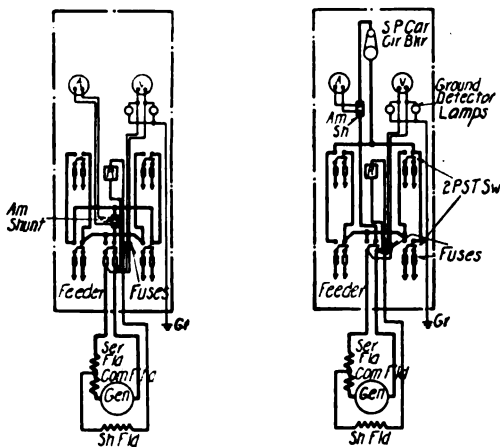
factory with full and complete information and Data Sheet properly filled out. However, **any change or substitution** of apparatus as listed by style number will necessitate obtaining a **new delivery date** from factory.

**Alterations from Panels Listed**—The panels listed by style number may be adapted to control a



TYPE JD D-C. COMBINATION  
GENERATOR-AND-FEEDER PANEL

### Typical Diagrams of Connections



PANEL WITH  
FUSED MAIN SWITCH

PANEL WITH  
CIRCUIT-BREAKER

smaller number of feeders than is specified, in which case a deduction from the price of the panel will be made for each feeder circuit omitted, as follows:

	Deduction from panel List Price
30-ampere circuit.....	\$ 5 00
60-ampere circuit.....	8 00
100-ampere circuit.....	12 50
200-ampere circuit.....	16 50

**Panel style numbers** include the frame, with wall brace ends, the panel with apparatus mounted thereon according to schedule given, and necessary details and connections.

Each order for a switchboard should be accompanied by a **Data Sheet Form No. 2724** completely filled out.

See also Instructions for Ordering.

TYPE JD D-C. COMBINATION GENERATOR-AND-FEEDER PANELS—Continued

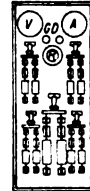
PANELS WITH FUSED GENERATOR SWITCH

110-220 Volts, Two-Wire, Direct-Current

For the Control of One Generator and Four Feeder Circuits

Schedule of Apparatus

- One ammeter, type SX.
- One voltmeter, type SX.
- One drilling only for Westinghouse rheostat mounting.
- One ground detector outfit.
- One fused knife switch, type A, 2-pole, single-throw.
- Two enclosed fuses.
- Four fused knife switches, type A, 2-pole, single-throw.
- Eight enclosed fuses.
- Five Cardholders.



Generator Switch	AMPERE CAPACITY Generator Fuses	Ammeter Full Scale	Each Feeder	Panel Width, Inches	110 Volts Style No.	List Price	220 Volts Style No.	List Price
100	100	200	30	20	334123	\$260 00	334134	\$262 00
100	100	200	60	20	334124	270 00	334135	272 00
200	150	200	30	20	334125	265 00	334136	267 00
200	150	200	60	20	334126	275 00	334137	277 00
200	200	300	60	20	334127	280 00	334138	282 00
200	200	300	100	20	334128	295 00	334139	297 00
400	300	400	60	20	334129	295 00	334140	297 00
400	300	500	100	20	334130	315 00	334141	317 00
400	400	600	100	20	334131	320 00	334142	322 00
400	400	600	200	24	334132	365 00	334143	367 00
600	600	1000	200	24	334133	385 00	334144	387 00

Approximate weight, boxed, 700 pounds.

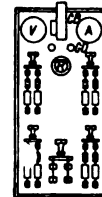
PANELS WITH CIRCUIT-BREAKER PROTECTION

110-220 Volts, Two-Wire, Direct-Current

For the Control of One Generator and Four Feeder Circuits

Schedule of Apparatus

- One ammeter, type SX.
- One voltmeter, type SX.
- One drilling only for Westinghouse rheostat mounting.
- One ground detector outfit.
- One knife switch, type A, 2-pole, single-throw.
- One circuit-breaker, type CL, carbon-break, single-pole.
- Four fused knife switches, type A, 2-pole, single-throw.
- Eight enclosed fuses.
- Five Cardholders.



Generator Switch	AMPERE CAPACITY Circuit-Breaker	Ammeter Full Scale	Each Feeder	Panel Width, Inches	110 Volts Style No.	List Price	220 Volts Style No.	List Price
100	100	200	30	24	334145	\$300 00	334156	\$302 00
100	100	200	60	24	334146	310 00	334157	312 00
200	150	200	30	24	334147	315 00	334158	317 00
200	150	200	60	24	334148	325 00	334159	327 00
200	200	300	60	24	334149	330 00	334160	332 00
200	200	300	100	24	334150	350 00	334161	352 00
400	300	400	60	24	334151	345 00	334162	347 00
400	300	500	100	24	334152	365 00	334163	367 00
400	400	600	100	24	334153	410 00	334164	412 00
400	400	600	200	24	334154	445 00	334165	447 00
600	600	1000	200	24	334155	490 00	334166	492 00

Approximate weight, boxed, 700 pounds.

Order by Style Number

## TYPE JD THREE-WIRE D-C. SWITCHBOARD PANELS

**Application**—Type JD three-wire switchboards are designed for the control of from one to three generators in lighting and power plants of moderate capacity operating direct-current three-wire systems.

**Capacity**—The capacity of a single generator panel is limited to 800 amperes, and that of a complete switchboard composed of these panels to 1800 amperes. For greater capacities a switchboard composed of type GD panels is recommended.

**Type Designation**—According to the usual method of designating types of panels, the letter J signifies that the panel is mounted on a type J  $1\frac{1}{4}$ -inch pipe frame, and the second letter, D, indicates direct-current application.

**Panel Construction**—Each panel consists of a single section, 48 inches high,  $1\frac{1}{2}$  inches thick, with  $\frac{1}{4}$ -inch bevels on front edges, bolted at the four corners to the switchboard frame. The frame is made of  $1\frac{1}{4}$ -inch pipe uprights, resting on tapped floor flanges with the necessary panel brackets to which the panel is bolted. The total height of the panel is 76 inches.

**Instruments**—Type SX ammeters and voltmeters, as specified, are regularly furnished with these panels.

For panels having four-pole circuit breaker protection, the ammeter shunts are located on the generator frames, whereas those with two-pole circuit breaker protection have their shunts located on the rear of the panels. Forty-foot shunt leads are, therefore, furnished with the ammeters on the former panels and standard leads are furnished with those on the latter.

**Switches**—Type A knife switches, either single- or double-throw, are used on generator and feeder panels.

Switches are not provided for disconnecting the balance coil from the collector rings on the generator, as these circuits can be opened by lifting the collector brushes. If switches are desired in these circuits, one double-pole single-throw knife switch can be provided at an additional price and mounted on the panel, or on a sub-panel. The omission of this switch from the balance-coil circuit effects a saving, as it eliminates the necessity of running four cables from the collector brushes and balance coil to the switchboard.

**Automatic Protection**—Automatic protection for the generator circuit is provided by a 4-pole, type CL, carbon circuit-breaker automatically tripped through relays actuated by the full armature current, or by a two-pole, type CL, double-coil overload carbon breaker.

Automatic protection for feeder circuits is provided by (a) two-pole circuit-breakers, (b) three single-pole circuit-breakers actuated by a common trip, or (c) enclosed fuses.

**Shipment**—Any single standard panel can be shipped within 15 days after receipt of order at the Works giving full and complete information.

This promise of delivery applies only when a standard panel is furnished without any changes or additions other than those authorized in this section.

**Connections**—The main connections on the back of the panel are of bare copper strap and are cut, bent, and assembled before shipment.

**Data Sheet**—Each order for a switchboard should be accompanied by a Switchboard Data Sheet, Form No. 2724, completely filled out. Full information given at the

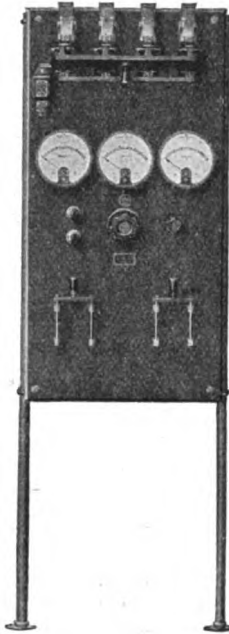
time of entering order prevents unnecessary correspondence and delay in shipment. See also Instructions for Ordering.

**Panel Style Number** includes the frame, with wall brace ends, the panel with apparatus mounted thereon according to schedules given, and the necessary details and connections for operating a single panel.

**Bus-bars** are not included in the style numbers and must be added separately.

**Equalizer Bus-bars**—Where generators are operating in parallel, positive and negative equalizer bus-bars are necessary in addition to the main bus-bars. These extend behind the generator panels but are not continued back of the feeder panels. Therefore when calculating the amount of copper in the bus-bars for parallel-operated generators on 3-wire service, it is necessary to add to the regular bus-bar material the copper required for the two equalizer bus-bars, each of a capacity equal to that of the largest generator.

**Generator panels not operating in parallel** do not require equalizer bus-bars, nor is a four-pole breaker required. When the generator operates singly, and future parallel operation is not contemplated, a two-pole breaker may be used, having its poles connected in the main positive and negative circuits. The positive and negative equalizer leads will not be brought to the switchboard and the ammeter shunts will be mounted on the rear of the panel. The two-pole breaker will fulfill the requirements of the "National Electric Code" and yet only require two leads between generator and switchboard.



TYPE JD 3-WIRE SWITCHBOARD PANEL

TYPE JD 3-WIRE D-C. SWITCHBOARD PANELS—Continued

**Omission of Feeder Circuits**—A reduction in price is allowed for the omission of feeder circuits from panels as follows:

Ampere-Capacity Circuit	REDUCTION FROM LIST PRICE PER CIRCUIT		
	Single-Throw Switch Fuses on Front	Single-Throw Switch Fuses on Rear	Double-Throw Switch Fuses on Rear
30	\$ 7 50	\$15 75	\$19 50
60	12 25	17 50	22 00
100	18 00	29 00	32 50
200	24 50	31 00	38 50
300	45 00	50 00	60 00
400	50 00	58 50	64 00

**Two-Wire Circuits**—A full line of feeder panels for the control of two-wire circuits is given in another part of this section.

These panels may easily be adapted for two wire circuits fed from three-wire bus-bars.

Order panels for this service as follows: "Panel similar to Style No.....but adapted to feed from three-wire bus."

GENERATOR PANELS

Four-Pole Circuit-Breaker Protection

To control one direct-current three-wire generator, operating singly or in parallel

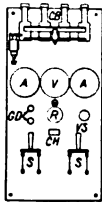


FIG. 1

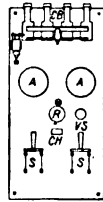


FIG. 2

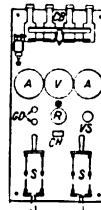


FIG. 3

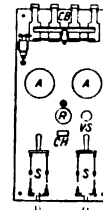


FIG. 4

For a single-throw system, order panel Fig. 1 for first machine installed and Fig. 2 for each succeeding machine.

For a double-throw system, order panel Fig. 3 for first two machines installed and Fig. 4 for each succeeding machine.

Schedule of Apparatus

- One switchboard panel.
- One voltmeter, type SX.
- One voltmeter switch handle.
- One ground detector.
- Two ammeters, type SX, with shunts for mounting on machine frame.
- One drilling for Westinghouse tetrapod rheostat mounting.
- One voltmeter switch, type RS, double-pole.

- One carbon circuit-breaker, type CL, 4-pole with low-voltage release mechanism.
- Two overload relays, type TO, mounted on rear of panel, actuated by the total armature current (from ammeter shunts) to trip the carbon breaker.
- Two knife switches, type A, two-pole.
- One cardholder.

AMPERE CAPACITY	Switch	CAPACITY	Ammeter	Panel Width Inches	Maximum KW. 250 Volts	Panel Style No.	LIST PRICE		Panel Style No.	LIST PRICE	
							Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
<b>Single-Throw System</b>											
						Fig. 1			Fig. 2		
100	100	150	24	25	334167	\$500 00	\$520 00	334174	\$460 00	\$480 00	
200	150	200	24	37.5	334168	535 00	555 00	334175	495 00	515 00	
200	200	300	24	50	334169	540 00	560 00	334176	500 00	520 00	
400	300	500	24	75	334170	560 00	580 00*	334177	520 00	540 00	
400	400	600	24	100	334171	750 00	775 00	334178	710 00	735 00	
600	600	1000	32	150	334172	905 00	940 00	334179	865 00	900 00	
800	800	1200	32	200	334173	1065 00	1100 00	334180	1025 00	1060 00	
<b>Double-Throw System</b>											
						Fig. 3			Fig. 4		
100	100	150	24	25	334181	515 00	540 00	334187	475 00	500 00	
200	150	200	24	37.5	334182	550 00	575 00	334188	510 00	535 00	
200	200	300	24	50	334183	555 00	580 00	334189	515 00	540 00	
400	300	500	24	75	334184	580 00	615 00	334190	540 00	575 00	
400	400	600	24	100	334185	775 00	815 00	334191	735 00	775 00	
600	600	1000	32	150	334186	945 00	1000 00	334192	905 00	960 00	

Approximate weight, boxed, 700 pounds.

Order by Style Number

TYPE JD 3-WIRE D-C. SWITCHBOARD PANELS—Continued

GENERATOR PANELS

Two-Pole Circuit-Breaker Protection

To control one direct-current three-wire generator, operating singly or in parallel

With 3-wire direct-current generators, the National Electrical Code requires that the "safety device consist of either: (1) a double-pole double-coil overload circuit-breaker, or (2) a four-pole circuit-breaker connected in the main and equalizer leads, and tripped by means of two overload devices, one in each armature lead." In short, the National Electrical Code requires that the safety device be actuated by the full armature current.

A comparison between the two methods shows the following:

Two-Pole Breaker Protection Requires

- 2-pole carbon breaker.
- Six leads between generator and switchboard. (See diagram of connections.)
- Cable duct and installation of same for six main generator leads.
- Ammeter shunts mounted on switchboard.
- Two sets of short ammeter shunt leads.

Four-Pole Breaker Protection Requires

- 4-pole carbon breaker with low-voltage release device for tripping by relays.
- Two overload relays.
- Four leads between generator and switchboard. (See diagram of connections.)
- Cable duct and installation of same for four main generator leads.

Ammeter shunts mounted on generator frame. Four sets of ammeter-shunt leads of a length at least sufficient to reach from ammeter shunt on generator frame to meters and relay on board, through main lead or separate ducts.

From the above comparison, it can be seen that the cost of the switchboard panel equipment is greater with the 4-pole breaker protection than with the 2-pole breaker protection. However, the added cable and cable duct cost, including also the added expense of installation, may be found to make the cost of the total equipment greater with the former method of protection than with the latter. This becomes true as the distance between the generator and the switchboard increases, and as the size of the cables and ducts increases.

The following table gives the distances between generator and switchboard beyond which it will be found in general that the total equipment cost of 2-pole breaker protection will be greater than total equipment cost of 4-pole breaker protection.

200 kw	250-volt generator	18 feet
150 kw	250-volt generator	22 feet
100 kw	250-volt generator	28 feet
75 kw	250-volt generator	33 feet
60 kw	250-volt generator	38 feet
50 kw	250-volt generator	40 feet
25 kw	250-volt generator	50 feet

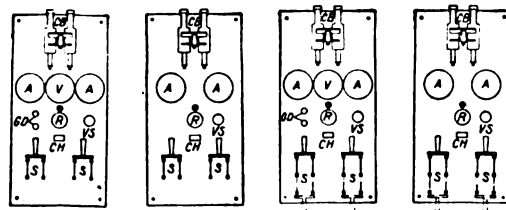
Schedule of Apparatus

For a single-throw system, order panel Fig. 1 for first machine installed and Fig. 2 for each succeeding machine.

For a double-throw system, order panel Fig. 3 for first two machines installed and Fig. 4 for each succeeding machine.

- One switchboard panel.
- One voltmeter, type SX.
- One voltmeter switch-handle.
- One lamp ground detector outfit.
- Two ammeters, type SX, with shunts mounted on panel.
- One drilling for Westinghouse tetrapod rheostat mounting.
- One voltmeter switch, type RS, double-pole.

} with panels  
Figs. 1 and 3  
only.



- One carbon breaker, type CL, 2-pole double-coil overload.
- Two knife switches, type A, two-pole, single-throw, with Figs. 1 and 2; double-throw with Figs. 3 and 4.
- One Cardholder.

AMPERE CAPACITY Switch Breaker	AMPERE CAPACITY Ammeter	Panel Width Inches	Max. K. W. 250 Volts	Panel Style No.	LIST PRICE		Panel Style No.	LIST PRICE		
					Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation	
<b>Single-Throw System</b>										
Fig. 1					Fig. 2					
100	100	150	24	25	334193	\$350 00	\$370 00	334200	\$310 00	\$330 00
200	150	200	24	37.5	334194	355 00	375 00	334201	315 00	335 00
200	200	300	24	50	334195	360 00	385 00	334202	320 00	345 00
400	300	500	24	75	334196	385 00	415 00	334203	345 00	375 00
400	400	600	24	100	334197	475 00	505 00	334204	435 00	465 00
600	600	1000	32	150	334198	570 00	600 00	334205	530 00	560 00
800	800	1200	32	200	334199	650 00	680 00	334206	610 00	640 00
<b>Double-Throw System</b>										
Fig. 3					Fig. 4					
100	100	150	24	25	334207	360 00	390 00	334213	320 00	350 00
200	150	200	24	37.5	334208	375 00	405 00	334214	335 00	365 00
200	200	300	24	50	334209	380 00	420 00	334215	340 00	380 00
400	300	500	24	75	334210	410 00	455 00	334216	370 00	415 00
400	400	600	24	100	334211	500 00	545 00	334217	460 00	505 00
600	600	1000	32	150	334212	605 00	650 00	334218	565 00	610 00

Approximate weight, boxed, 500 pounds.

Order by Style Number

TYPE JD 3-WIRE D-C. SWITCHBOARD PANELS—Continued

FEEDER PANELS WITH FUSE PROTECTION

To control one or more feeder circuits

Schedule of Apparatus

One switchboard panel.

Per circuit—

One knife switch, type A, 3-pole. Switches arranged in two vertical rows as shown in the figures, or in one row, according to the space requirements of the switch.

Three enclosed fuses with holders (mounted on rear of panel for Figs. 1 and 2).

One cardholder.

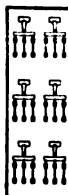


Fig. 1

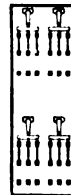


Fig. 2



Fig. 3

Panel Width Inches	Ampere No. Circuits Controlled	Fig.	Capacity Circuit	Panel Style No.	LIST PRICE	
					Individual Operation	Bus-Bar Operation
16	10	1	30	179383	\$360 00	\$385 00
16	5	1	60	179384	245 00	265 00
16	4	1	100	179385	265 00	285 00
16	3	1	200	179386	245 00	270 00
16	3	1	300*	179387	385 00	410 00
16	3	1	400	179388	390 00	415 00
20	15	1	30	179389	450 00	485 00
20	10	1	60	179390	375 00	410 00
20	8	1	100	179391	425 00	460 00
24	6	1	200	179392	415 00	455 00
24	6	1	300*	179393	685 00	725 00
24	6	1	400	179394	700 00	740 00
16	6	2	30	179395	290 00	325 00
16	3	2	60	179396	220 00	255 00
16	2	2	100	179397	205 00	240 00
16	2	2	200	179398	220 00	360 00
16	2	2	300*	179399	330 00	370 00
16	2	2	400	179400	345 00	385 00
20	9	2	30	179401	280 00	335 00
20	6	2	60	179402	330 00	380 00
20	4	2	100	179403	315 00	365 00
24	4	2	200	179404	375 00	455 00
24	4	2	300*	179405	605 00	685 00
24	4	2	400	179406	620 00	700 00
16	8	3	30	179407	260 00	285 00
16	4	3	60	179408	185 00	210 00
16	3	3	100	179409	195 00	220 00
16	2	3	200	179410	180 00	205 00
16	2	3	300*	179411	255 00	280 00
16	2	3	400	179412	265 00	290 00
20	12	3	30	179413	330 00	360 00
20	8	3	60	179414	285 00	315 00
20	6	3	100	179415	295 00	325 00
24	4	3	200	179416	285 00	335 00
24	4	3	300*	179417	420 00	470 00
24	4	3	400	179418	435 00	485 00

\*Capacity of switch is 400 amperes, fuses 300 amperes.

Approximate weight, boxed, 500 pounds.

FEEDER PANELS WITH CIRCUIT-BREAKER PROTECTION

To control one or more feeder circuits

Schedule of Apparatus

For Fig. 1

- One switchboard panel.
- One circuit-breaker, type CL, 2-pole.
- One knife switch, type A, 3-pole, single-throw.
- One cardholder.

For Fig. 2

- One switchboard panel.
- One circuit-breaker, type CL, 2-pole.
- One knife switch, type A, 3-pole, double-throw.
- One cardholder.

For Fig. 3

- One switchboard panel.
- Three circuit-breakers, type CL, 3-pole, having

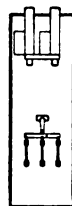


Fig. 1

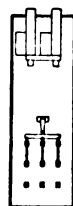


Fig. 2

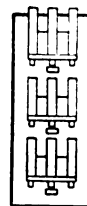


Fig. 3

two trip coils and with independently closing poles, the neutral pole closing first.

Three cardholders.

(Continued on next page)



TYPE JD 3-WIRE D-C. SWITCHBOARD PANELS—Continued

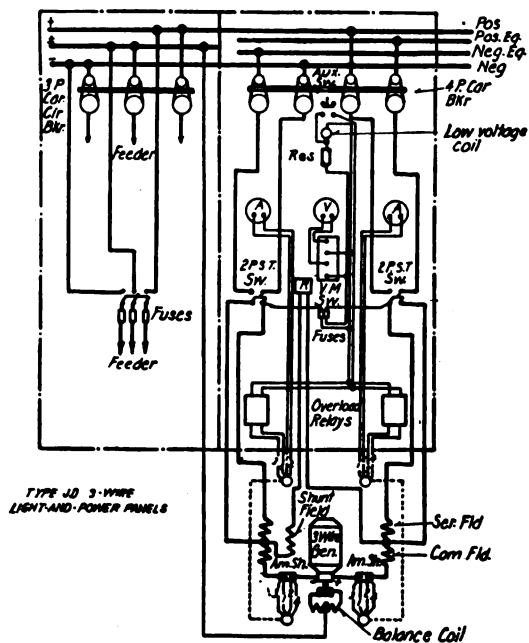
FEEDER PANELS WITH CIRCUIT-BREAKER PROTECTION—Continued

Panel Width Inches	Ampere Capacity Circuit	Fig.	Panel Style No.	LIST PRICE	
				Individual Operation	Bus-Bar Operation
16	30	1	179419	\$170 00	\$185 00
16	60	1	179420	175 00	190 00
16	100	1	179421	180 00	195 00
16	150	1	179422	190 00	205 00
16	200	1	179423	195 00	210 00
16	300	1	179424	210 00	225 00
16	400	1	179425	300 00	325 00
16	30	2	179426	180 00	200 00
16	60	2	179427	185 00	205 00
16	100	2	179428	190 00	210 00
16	150	2	179429	200 00	220 00
16	200	2	179430	205 00	225 00
16	300	2	179431	225 00	245 00
16	400	2	179432	315 00	340 00
20	30	3	179433	440 00	480 00
20	60	3	179434	450 00	470 00
20	100	3	179435	480 00	480 00
20	150	3	179436	485 00	505 00
20	200	3	179437	495 00	515 00
20	300	3	179438	510 00	530 00
20	400	3	179439	1125 00	1150 00

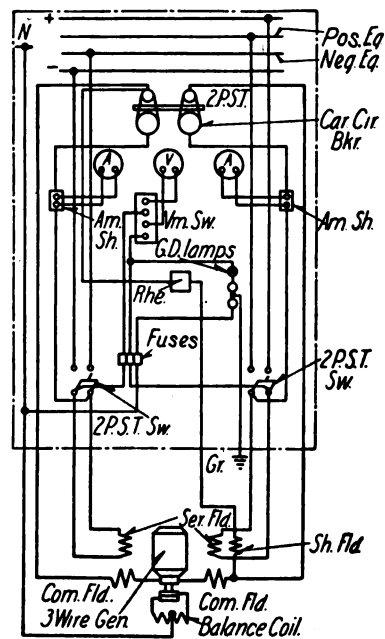
Approximate weight, boxed, 500 pounds.

Order by Style Number

DIAGRAMS OF TYPICAL CONNECTIONS



FOUR-POLE CIRCUIT-BREAKER PROTECTION



TWO-POLE CIRCUIT-BREAKER PROTECTION

## TYPE JD ARC-WELDING PANELS

**General**—Welding by means of the electric arc is accomplished by drawing an arc between a metal or carbon electrode of an electric circuit, and the metals to be welded. The electrode is usually the negative terminal of the circuit, whereas the metal to be welded is the positive terminal. Direct current is commonly used for arc welding, as it requires less current than alternating for the same welding effect and also gives the better results.

Arc welding is divided into two commercial processes: Carbon, or Graphite, Electrode Process, in which the arc is drawn between metal to be welded and a carbon, or graphite, electrode; and the Metal Electrode Process, in which the arc is drawn between metal to be welded and a metal electrode.

The current for arc welding is usually obtained from a specially designed low-voltage direct-current generator which, in most cases, is motor-driven. The current may be obtained also from any convenient direct-current source. Several welding circuits can be connected to one generator circuit, the number depending on the capacity of the generating equipment and on the number of operators working at any one time.

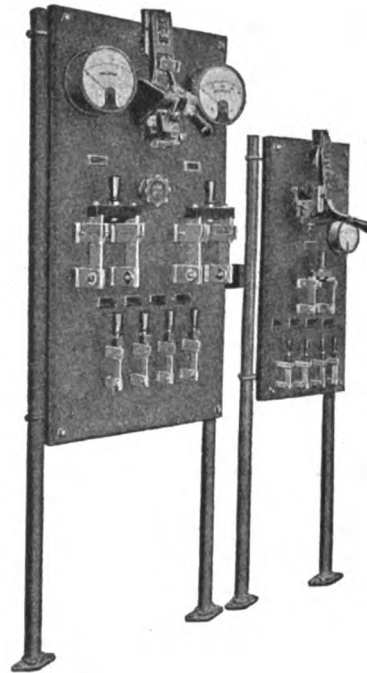
Where only one welding circuit is connected to the generator, both the generator circuit and the welding circuit may be controlled from a single switchboard panel, which is known as a **combination control panel**, or an individual generator panel may be used to control the generator and a separate outlet panel to control the welding circuit. Where several welding circuits are connected to one generator circuit, the generator may be controlled either from a separate generator panel or from a combination control panel; in the latter case one of the welding circuits is connected to the combination panel and the remainder to outlet panels, while in the former case an outlet panel must be provided for each welding circuit.

Arc-welding switchboard panels designed for controlling the generator and welding circuits of stationary electric-arc-welding equipments are listed in the following pages.

All equipment listed is for a **service voltage of 60 volts**.

**Portable Equipments**—Westinghouse arc-welding equipments in capacities of 175, 300, and 500 amperes can also be supplied for portable service when required. For this service, equipments are modified so as to reduce weight and size, and are mounted on trucks. See Catalogue No. 30, "Westinghouse Direct-Current Motors and Generators."

**Application**—The main control panels listed are of two general classes: The **combination generator-and-welding panels** (Class I), arranged for the control of the generator and one welding circuit; and the **generator panels** (Class II), arranged for the



COMBINATION GENERATOR AND WELDING PANEL  
WITH PANEL OUTLET

control of the generator only and requiring separate welding outlet panels.

The **welding outlet panels** listed are of four different forms depending on the nature of the work for which they are required: type A—panels for metal electrode work exclusively; type B—light combination panels for metal and light graphite electrode work; type C—panels for graphite work exclusively; and type D—heavy combination panels for metal and heavy graphite work.

The graphite electrode process is in general best adapted for cutting metal, and for use on the heavier and rougher classes of work, that is, where the weld is large and where strength is not of first importance.

The metallic electrode process finds its greatest use on the finer grades of work, that is, where the welds are small or the strength is of prime importance, or where the maximum localization of heat is required.

**Capacity**—The class I combination generator-and-welding panels listed range in capacities from 300 amperes to 1000 amperes. On the 1000-ampere combination panel the control for the welding circuit is of 750 amperes capacity; on all other combination panels the control for the welding circuit is of the same maximum capacity as the generator. The separate generator panels are listed for capacities ranging from 300 to 1000 amperes; the outlet panels are listed for capacities of 225, 350 and 600 amperes.

TYPE JD ARC-WELDING PANELS—Continued

**Panel Construction**—Each panel consists of a single section, 48 inches high by 16, 20 or 24 inches wide, and 1½ inches thick, ¼-inch bevels on front edges, except the metal-electrode outlet panel, which is 36 inches high. All panels, except the metal-electrode outlet panel, are mounted on 1¼-inch type J pipe frames, the total height of which is 76 inches. The metal-electrode outlet panel is mounted on 1¼-inch type N pipe frame, 64

inches high. All panels are furnished complete with wall braces.

**Automatic Protection**—Single-pole carbon circuit-breakers provide automatic overload protection for both the generator and welding circuits.

**Panel Style Numbers** include the frame, the panel with apparatus mounted thereon according to schedules given, and necessary details and connections.

CLASS I—COMBINATION GENERATOR-AND-WELDING PANELS

To control one generator and one welding circuit of the same capacity as the generator, except the 1000-ampere size panel, which has a 750 ampere welding circuit

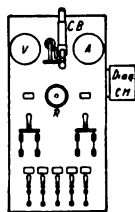


FIG. 1

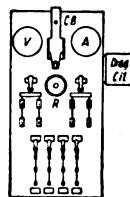


FIG. 2

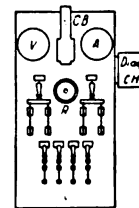


FIG. 3

Schedules of Apparatus

300-Ampere Panel (Fig. 1)

- One carbon circuit-breaker, type CL, single-pole, with dashpot inverse-time-limit attachment.
  - One ammeter, type SX, complete with ammeter shunt.
  - One voltmeter, type SX.
  - Two knife switches, type A, two-pole, single-throw.
  - Five knife switches, type A, single-pole, single-throw.
  - One drilling for standard Westinghouse tetrapod rheostat mounting.
  - Seven cardholders.
  - One diagram, in holder, listing switch combinations required to obtain the various welding currents.
- Apart from panel—**
- One welding resistor.

500-Ampere Panel (Fig. 2)

- One carbon circuit-breaker, type CL, single-pole, with dashpot inverse-time-limit attachment.
- One ammeter, type SX, complete with ammeter shunt.
- One voltmeter, type SX.
- Two knife switches, type A, two-pole, single-throw.

Four knife switches, type A, single-pole, double-throw.

- Ten cardholders.
- One diagram, in holder, listing switch combinations required to obtain the various welding currents.
- One drilling for standard Westinghouse tetrapod rheostat mounting.

**Apart from panel—**

One welding resistor.

500, 750 and 1000-Ampere Panels (Fig. 3)

- One carbon circuit-breaker, type CL, single-pole, with dashpot inverse-time-limit attachment.
- One ammeter, type SX, complete with ammeter shunt.
- One voltmeter, type SX.
- Two knife switches, type A, two-pole, single-throw.
- Four knife switches, type A, single-pole, single-throw.
- Six cardholders.

- One diagram, in holder, listing switch combinations required to obtain the various welding currents.
- One drilling for standard Westinghouse tetrapod rheostat mounting.

**Apart from panel—**

One welding resistor.

Fig.	Panel Rating Amperes	AMPERE RANGE		NUMBER OF STEPS		Panel Width Inches	Weight Lbs. Boxed	Panel Style No.	List Price
		Metal Electrode	Carbon Electrode	Metal Electrode	Carbon Electrode				
1	300	25-190	225-350	15	14	24	650	359817	\$525 00
1	300	25-375	150-350	15	15	24	650	359818	570 00
2	500	15-225	125-650	15	14	24	850	359819	660 00
3	500	.....	150-550	..	6	24	750	359820	595 00
3	750	.....	250-750	..	8	24	950	359821	665 00
3	1000	.....	250-750	..	8	24	1000	359822	780 00

Order by Style Number

TYPE JD ARC-WELDING PANELS—Continued

CLASS II—GENERATOR PANELS

300, 500, 750 and 1000 Amperes

Panel to be used for the control of generator

Schedule of Apparatus

- One carbon circuit-breaker, type CL, with dashpot inverse-time-limit attachment.
- One ammeter, type SX, complete with ammeter shunt.
- One voltmeter, type SX.
- One knife switch, type A, two-pole, single-throw.
- One cardholder.
- One drilling for standard Westinghouse tetrapod rheostat mounting.

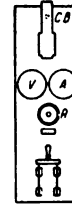


FIG. 4

Ampere Capacity	Panel Width Inches	Weight Lbs. Boxed	Panel Style No.	List Price
300	16	300	359823	\$320 00
500	16	350	359824	375 00
750	16	450	359825	400 00
1000	20	500	359826	525 00

WELDING OUTLET PANELS

Each panel to control welding circuit for one operator on metal or graphite electrode service up to maximum capacity listed below

Schedule of Apparatus

Light Combination and Individual Metal or Graphite Panels (Figs. 5 and 6)

- One carbon circuit-breaker, type CL, with dashpot inverse-time-limit attachment.
- One ammeter, type DX, with shunt.
- One knife switch, type A, two-pole, single-throw.
- §Four knife switches, type A, single-pole, single-throw.
- §Five card holders.

One diagram, in holder, listing switch combinations required to obtain the various welding currents.

Apart from panel—

- One welding resistor.

Heavy Combination Panel (Fig. 7)

- One carbon circuit-breaker, type CL, with dashpot inverse-time-limit attachment.
- One ammeter, type DX, with shunt.
- One knife switch, type A, two-pole, single-throw.

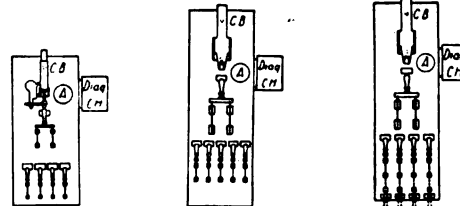


FIG. 5

FIG. 6

FIG. 7

Four knife switches, type A, single-pole, double-throw.

Nine card holders.

One diagram, in holder, listing switch combinations required to obtain the various welding currents.

Apart from panel—

- One welding resistor.

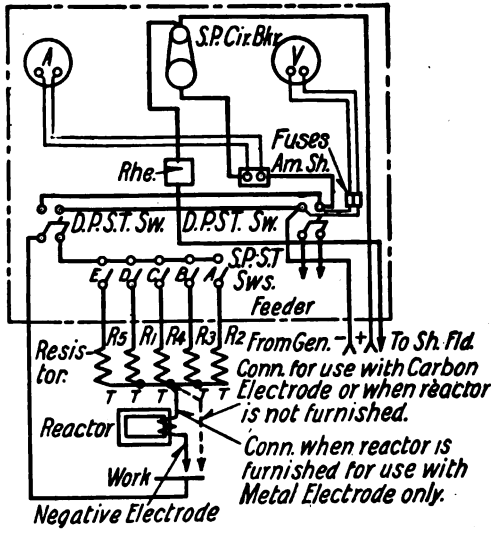
§Type B panel has five S. P. S. T. switches and six cardholders.

Fig.	Type	AMPERE RANGE		NUMBER OF STEPS		Panel Width Inches	Weight Lbs. Boxed	Panel Style No.	List Price
		Metal Electrode	Graphite Electrode	Metal Electrode	Graphite Electrode				
5	A	15-225	.....	15	..	16	350	359827	\$300 00
6	B	25-190	225-350	16	14	16	450	359828	450 00
6	B	25-375	150-350	16	14	16	450	366402	475 00
6	C	.....	150-550	..	6	16	600	359829	480 00
7	D	15-225	125-650	15	14	16	700	359830	575 00
7	D	25-375	125-650	15	14	16	700	359831	625 00

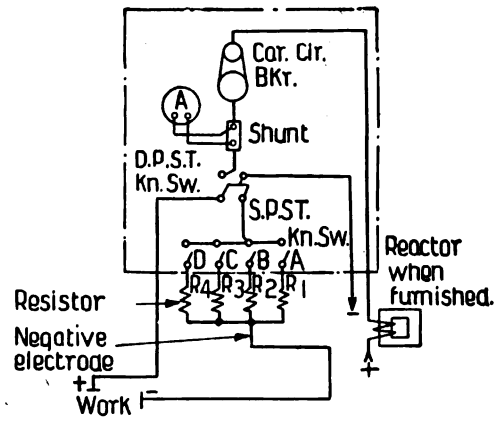
Order by Style Number

TYPE JD ARC-WELDING PANELS—Continued

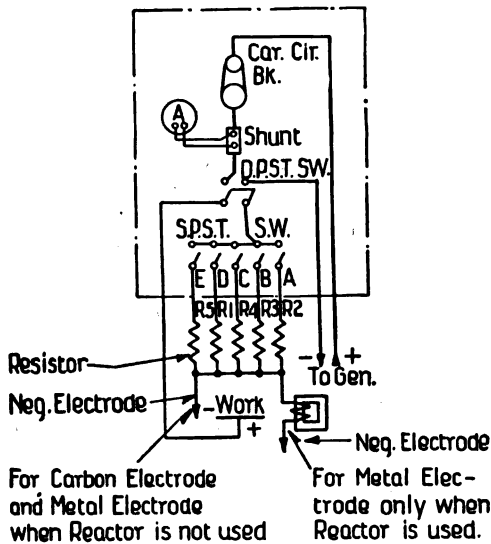
DIAGRAMS OF TYPICAL CONNECTIONS



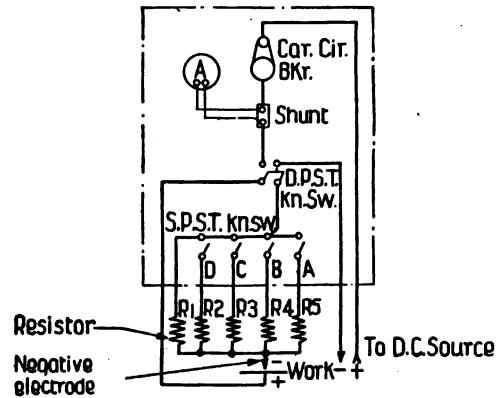
CLASS I—COMBINATION GENERATOR-AND-WELDING PANEL



TYPE A—METAL ELECTRODE OUTLET PANEL



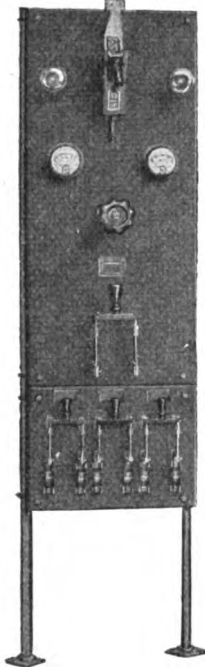
TYPE B—COMBINATION CARBON-AND-METAL ELECTRODE OUTLET PANEL



TYPE C—CARBON ELECTRODE OUTLET PANEL

## TYPE KD GENERATOR AND FEEDER PANELS

### DIRECT-CURRENT



TYPE KD GENERATOR AND FEEDER PANEL

**Application**—Type KD generator and feeder panels are designed to provide a complete switchboard in a single panel of one or two sections to control one generator with not more than four feeders. They are intended for small isolated plants operating direct-current systems of 250 volts or less.

**Capacity**—The capacity of a panel is limited to 400 amperes for the generator; and 200 amperes for each of two feeder circuits, or 60 amperes for each of four feeder circuits. Each panel forms a complete switchboard and is not designed to have panels added to it.

**Panel Construction**—The panel consists essentially of either one or two sections 1 inch thick, 16 inches wide, with  $\frac{1}{4}$ -inch bevel on front edges; the upper section being 24 or 36 inches high, and the lower section 12, 18 or 24 inches high. The upper section contains the apparatus for the control of the generator and the lower section contains that for the control of the various feeder circuits. The total height of the panel is 64 inches.

**Type Designation**—According to the usual method of designating types of panels, the letter K signifies that the panel is mounted on a type K  $\frac{3}{4}$ -inch pipe frame, and the second letter D indicates direct current application.

Various sizes of the type KD panels are designated by the addition of sub-numbers to the type letters as follows:

- Type KD panel is 36 inches high.
- Type KD-1 panel is 48 inches high (36+12).
- Type KD-2 panel is 54 inches high (36+18).
- Type KD-3 panel is 60 inches high (36+24).
- Type KD-4 panel is 24 inches high.
- Type KD-5 panel is 36 inches high (24+12).
- Type KD-6 panel is 42 inches high (24+18).
- Type KD-7 panel is 48 inches high (24+24).

**Switches**—Type A single-throw knife switches are used for generator and feeder circuits. When it is desired to provide for a separate source of power, the generator panel can be furnished with a double-throw switch at an additional price. This switch will be mounted horizontally instead of vertically.

**Automatic protection** is provided for the generator circuit by: (1) a single-pole type F carbon circuit-breaker up to 75 amperes, (2) type CL carbon circuit-breaker, or by (3) enclosed fuses mounted on the front of the panel. Feeder circuits are protected by enclosed fuses mounted on the front of the panel.

**Shipment**—Any type KD panel listed, or combination of a generator panel with its feeder sub-section, can be shipped within 15 days from receipt of order at the factory. It should be noted that this promise of delivery applies only when a standard panel, without changes or additions, is ordered. Drawings will not be furnished for approval.

**Connections**—The main connections on the back of the panel are of bare copper strap and are cut, bent, and put in place before shipment.

**Wall Brackets**—If it is desired to mount the panel on the wall, four wall brackets, Style No. 116313, should be ordered and the type K frame omitted with a reduction in the list price of \$1.50.

Refer also to section on "Switchboard Accessories" under "Switchboard Frames" for more complete details of frame.

**Style number includes** the panel and frame with wall or floor braces with the schedule of apparatus listed, including necessary details and connections for operating the panel.

**Orders** for panels, where any variation from the style number panels is required, must be accompanied by a **Data Sheet, Form No. 2724**, properly filled out.

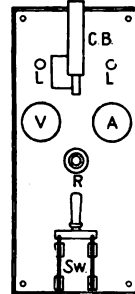
Also see "Instructions for Ordering."

TYPE KD GENERATOR AND FEEDER PANELS—Continued

**GENERATOR PANELS**  
**With Circuit-Breaker Protection**

**Schedule of Apparatus**

- One carbon circuit-breaker, single-pole; type CL for type KD panel, type F for type KD-4 panel.
- One ammeter, type CX.
- One voltmeter, type CX.
- One ground detector outfit.
- Drilling only, for Westinghouse tetrapod rheostat mounting.
- One knife switch, type A for 100 amperes and above, type C (rear-connected) below 100 amperes, two-pole, single-throw.



TYPE KD

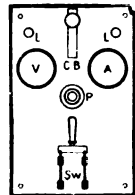
Panel	AMPERE CAPACITY			50 Volts Style No.	List Price	125 Volts Style No.	List Price	250 Volts Style No.	List Price
	Switch	Breaker	Ammeter						
<b>Type KD†—36" x 16" x 1"</b>									
25	30	25	50	334248	\$185 00	334254	\$187 00	334261	\$190 00
50	60	50	75	334249	190 00	334255	192 00	334262	195 00
100	100	100	150	334250	195 00	334256	197 00	334263	200 00
150	200	150	200	.....	.....	334257	202 00	334264	205 00
200	200	200	300	334251	205 00	334258	207 00	334265	210 00
300	400	300	500	334252	215 00	334259	217 00	334266	220 00
400	400	400	600	334253	250 00	334260	252 00	334267	255 00

Approximate weight, boxed, 175 pounds.

Panel	AMPERE CAPACITY			50 Volts Style No.	List Price	125 Volts Style No.	List Price	250 Volts Style No.	List Price
	Switch	Breaker	Ammeter						
<b>Type KD-4†—24" x 16" x 1"</b>									
12	30	12½	25	334268	173 00	334272	175 00	334276	178 00
25	30	25	50	334269	173 00	334273	175 00	334277	178 00
50	60	50	75	334270	178 00	334274	180 00	334278	183 00
75	100	75	150	334271	183 00	334275	185 00	334279	188 00

Approximate weight, boxed, 160 pounds.

†See preceding page for type designation when supplied with feeder section.



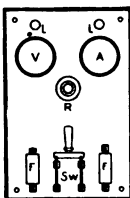
TYPE KD-4

**With Fuse Protection**

**Schedule of Apparatus**

- One ammeter, type CX.
- One voltmeter, type CX.
- One ground detector outfit.
- Drilling only, for Westinghouse tetrapod rheostat mounting.
- One knife switch, type A for 100 amperes and above, type C (rear-connected) below 100 amperes, two-pole, single-throw.
- Two enclosed fuse blocks and fuses.

Panel	AMPERE CAPACITY			125 Volts Style No.	List Price	250 Volts Style No.	List Price
	Switch	Fuses	Ammeter				
<b>Type KD-4†—24" x 16" x 1"</b>							
10	30	10	25	334280	155 00	334288	158 00
20	30	20	50	334281	155 00	334289	158 00
30	30	30	50	334282	158 00	334290	159 00
50	60	50	75	334283	160 00	334291	162 00
60	60	60	100	334284	162 00	334292	165 00
100	100	100	150	334285	165 00	334293	168 00
150	200	150	200	334286	167 00	334294	170 00
200	200	200	300	334287	170 00	334295	173 00



Approximate weight, boxed, 160 pounds.

Panel	AMPERE CAPACITY			125 Volts Style No.	List Price	250 Volts Style No.	List Price
	Switch	Fuses	Ammeter				
<b>Type KD†—36" x 16" x 1"</b>							
300	400	300	500	334296	200 00	334298	205 00
400	400	400	600	334297	205 00	334299	210 00

Approximate weight, boxed, 200 pounds.

†See preceding page for type designation when supplied with feeder section.

**Order by Style Number**

TYPE KD GENERATOR AND FEEDER PANELS—Continued

FEEDER SECTIONS

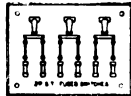
For Types KD and KD-4 Generator Panels  
With Fuse Protection—50 to 250 Volts

Schedule of Apparatus  
Per Circuit:

One fused knife switch, type A for 100 and 200 amperes, type C (rear connected) for 30 and 60 amperes, two-pole, single-throw, with enclosed fuses.

One cardholder.

No. of Circuits	AM. Each Circuit	CAPACITY Fused Switch	Height of Section Inches	Style No.	List Price
2	30	30	12	268681	\$ 55 00
3	30	30	12	268682	70 00
2	60	60	12	268683	60 00
3	60	60	24	268684	75 00
4	60	60	24	268685	90 00
2	100	100	18	268686	80 00
2	200	200	24	268687	100 00

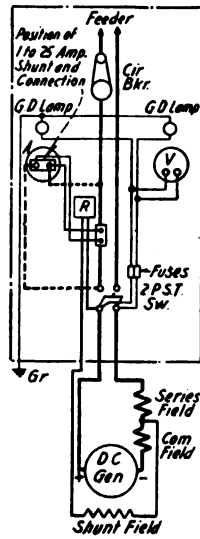


THREE CIRCUIT FEEDER SECTION

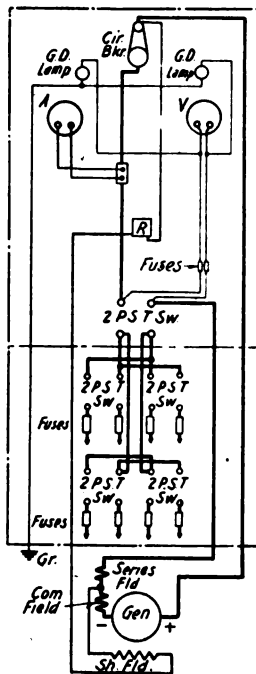
Approximate weight, boxed, 50 pounds.

Order by Style Number

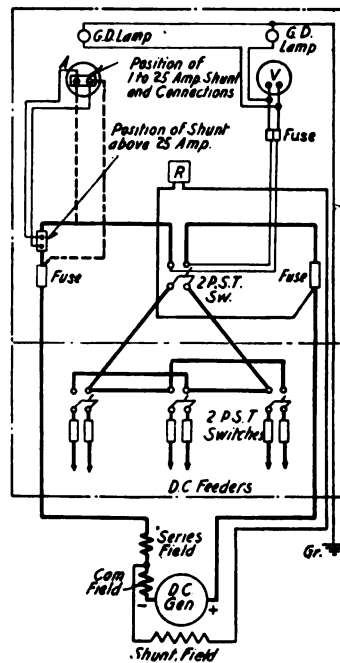
DIAGRAMS OF TYPICAL CONNECTIONS



K D Generator Panel  
Circuit Bkr. Protection.



K D Generator Panel, Circuit Breaker  
Protection, with Fused Feeders.



K D Fused Generator and Feeder Panel



## TYPE SD BATTERY-CHARGING PANELS

### For Charging Electric Vehicle Batteries

#### SECTIONAL TYPE

#### For D-C. Service

#### Application

These panels and sections are designed primarily for use in public and private garages where electric vehicle batteries will be charged. The charging rheostats specified are designed for charging from a normal 115-volt direct-current generator or incoming line batteries recommended by the Society of Automotive Engineers, namely: 40 to 44 cells for lead batteries and 60 to 62 cells for Edison batteries. Switchboards of this type can be furnished for charging batteries of a different number of cells or from a different voltage. Inquiries regarding these switchboards should be referred to the Company.

#### Distinctive Features

Each panel consists of a generator or instrument section and one or more charging sections, together with charging rheostats selected from those described in this section. This sectional construction provides a large variety of combinations, thus making an installation very flexible, as the number of charging circuits may be increased at any time after the switchboard has been installed, by the addition of suitable sections and rheostats. However, the combined capacity of the charging circuits used at one time must not exceed the capacity of the main section.

A switchboard built of these sections is very convenient and easy to operate, since the control of a large number of batteries is centralized. The equipment provides protection against reverse current, reverse polarity, and when an amperehour meter is used, provides for disconnecting the battery from the line or generator upon completion of charge. The entire equipment is simple to operate and the average garage employee can easily and efficiently attend to the charging of a large number of batteries at one time.

A section suitable for both charging and discharging may be applied to advantage in many cases. Since this section is of the standard type SD design, it may be included with standard charging sections on the switchboard.

Discharge sections of various ratings are provided. Owing to the large amount of power dissipated in the discharge resistances, no rheostat is supplied for discharging batteries. A water rheostat can easily be made from any wooden vessel containing water with a small amount of salt or soda in solution. By using the water rheostat, the cost of equipment is



TYPICAL BATTERY-CHARGING SWITCHBOARD

very materially reduced over what it would be if a separate resistance was supplied for discharge purposes.

Each battery charging rheostat consists of a self-contained resistor supported on the rear of each charging section with an operating handwheel on the front of the panel. With this construction, any rheostat may be readily removed and quickly repaired, in case of accidental injury, or replaced by another rheostat of different characteristics without disturbing the other sections.

#### Assembly of Sections

The sections of each panel are assembled one above another and securely bolted to a vertical angle iron frame of suitable height. The standard arrangement consists of a power-control section mounted at the top of panel with one or more charging sections mounted below it and a meter section (when required) at the side of the power-control section. It is not advisable to use panels exceeding 84 inches in height, because some of the switching apparatus

## TYPE SD BATTERY-CHARGING PANELS—Continued

would be inconveniently high for the operator. A panel 84 inches in height permits mounting one generator line or instrument section 28 inches high and three charging sections, or it will accommodate one generator or line section 14 inches high and four charging sections. When more sections are required than can be mounted on a frame 84 inches high, they may be arranged in two or more panels of uniform height. Where the number of necessary sections is not sufficient to make all panels the same height, blank sections may be readily added to some of the panels.

The frame will be made of such height that a space of  $6\frac{1}{2}$  inches or more will be left between the floor and the lower edge of the bottom section.

Every switchboard or panel which controls one or more direct current generators must be equipped with an individual power-control section for each generator. If generators are compound-wound and generator-control sections with circuit-breaker protection are used one side of the generator switch will be connected to the equalizer bars; the other side to the negative bus; and the circuit-breaker will be connected in the positive lead. If generator-control section provides fuse protection only, an equalizer switch must be provided.

### Regulations of National Board of Fire Underwriters

A Rule, incorporated in the National Electric Code, specifies that charging panels located in garages where gasoline is handled must have all spark-producing devices mounted 4 ft. or more above the floor. If such devices are mounted less than 4 ft. above the floor, the charging panel must be surrounded by a vapor-proof enclosure, unless the panel is located in a room or enclosure provided for this purpose.

Switchboards or panels controlling several charging circuits will regularly have the switching apparatus mounted less than 4 ft. above the floor and the purchaser will be expected to install the panels as provided for by the Code. In most cases, the simplest method is to mount the board on a concrete platform, 4 ft. high. If the purchaser desires that no spark-making device be mounted less than 4 ft. above the floor, such instructions should be furnished

the Company. A switchboard for control of a given number of charging circuits under these conditions will be composed of more panels than would be required otherwise.

### Regulations of the Safety Code

The arrangement of the panel sections, and combination of them, is such as to provide maximum protection to the operator. Power-control sections employing carbon circuit-breakers will be located at the top of the panel. The contactors on the charging sections are provided with blow-out coil and shield. The operator is thus protected against possible injury due to moving parts or to the arcing of automatic devices.

It is understood, however, that purchaser's operator is a competent operator as defined by the safety code and that purchaser will install any grill work, cage, or other means to keep unauthorized persons away from the switchboard.

### Construction of Sections

The various sections are made up of slabs 1 inch thick,  $\frac{1}{4}$ -inch bevel. These sections will be of two heights, 14 inches and 28 inches, depending upon the apparatus mounted on the section, as per schedules hereinafter given.

### Assembly and Connection of Panels

Each panel is completely assembled at the Works, with all copper detail connections properly formed and fitted. All connections between sections are designed to facilitate the addition of sections to the panels at a later date.

Each panel is furnished complete and forms a unit including framework and sockets for wall braces. Braces, however, are not included.

When horizontal bus-bars of small capacity for connecting two or more panels are required, they will be supported from the studs of the apparatus. If these horizontal bus-bars are of large capacity, brackets will be furnished for their support.

### Section Schedules

Following are the various sections listed:

	Charging Sections	{ With magnetically-operated switch	Schedule 1.	
		{ With magnetically-operated switch and discharge switch	Schedule 2.	
		{ Without magnetically-operated switch	Schedule 3.	
Power- Control Sections	Generator-Control Section	{ With relay protection.	Schedule 4.	
		{ With circuit-breaker protection.	Schedule 5.	
	Line-Control Section	{ With fused switch.	With low-voltage relay.	Schedule 6.
		{ With relay protection.	Schedule 7.	
		{ With circuit-breaker protection.	Schedule 8.	
		{ With fused switch	{ With low-voltage relay.	Schedule 9.
	{ Without low-voltage relay.	Schedule 10.		
	Automatic equipment.	Schedule 11.		
	Amperehour-meter Section.	Schedule 12.		
	Meter Section.	Schedule 13.		

## TYPE SD BATTERY-CHARGING PANELS—Continued

**Amperehour-Meter Sections**

Amperehour-meter sections are equipped with amperehour meters of the auto type, with a zero contact reset device and variable resistor element. The meter is designed so that it will run "slow" when the charging current of a battery passes through it, the speed being adjusted to approximately compensate for the charging efficiency of any battery. When a given number of amperehours for which the meter has been set have been supplied to the battery, the pointer will again be at the zero position and will close the zero contact; this will cause the contactor in the circuit to open, thus terminating the charge. Therefore to charge a battery, it is only necessary to set the meter pointer at the amperehours, as previously discharged from the battery, and when this number of amperehours (automatically corrected for charging efficiency by the resistor element of the meter) has been returned to the battery it will be automatically disconnected.

Each amperehour-meter section will be regularly furnished, drilled for one, two, or three amperehour meters.

When amperehour-meter sections are used, for the purpose of automatically terminating the charge of a battery, it is necessary to use charging sections, employing a contactor (see Schedule 1).

When an order is placed for these sections the Company should be advised the amperehour calibration desired for each meter, otherwise these will be furnished calibrated as deemed best by the Company.

**Field Rheostats for Direct-Current Generators**

Each power-control section to be used for the control of a direct-current generator is scheduled with drilling for a Westinghouse field rheostat mounting of the switchboard tetrapod type.

**Ground Detector Outfit**

Each switchboard that controls a source of power such as direct-current generator must be equipped with a ground detector outfit. For such panels, two 110-volt incandescent lamps are furnished and are mounted with the generator ammeter on a rigid panel attached to the side of the main panel framework. Each of the lamps is connected between one side of the line and ground, thus forming a continuous indicator. Under normal conditions each lamp will glow red due to the fact that it is operating on about one-half normal voltage. If the positive line becomes grounded, the lamp connected to that line will grow dim or cease to glow at all, while the other lamp will increase in brilliancy. If the negative side is grounded, the order of brilliancy is reversed. When power is received from incoming, direct-current lines the lamps are supplied in order that grounds on batteries may be detected.

**Limitation of Direct-Current Power-Control Section**

When a direct-current power-control section is required having a greater capacity than that of the largest direct-current power-control section scheduled, it will be necessary to select a separate 125-volt panel from the catalogue section covering type GD panels. To make all panels of uniform height, it will be necessary in most cases to add blank sections to one or more of the charging panels, or to increase the height of the generator panels.

**Automatic Protection**

For charging sections plain overload protection is regularly furnished for all sections. For this purpose there is furnished for each charging circuit National Electrical Code fuse holders and an enclosed fuse for each side of the circuit.

To protect the battery ammeter against overload, a fuse is provided and is connected between the battery ammeter bus-bar and the main negative bus-bar. This fuse is mounted on a bracket on the rear of the panel.

When it is desired to use two or more battery ammeters independently, each ammeter must be protected by its own fuse.

If each charging circuit is to be protected against reversal of current, it is necessary to select charging sections as per Schedule 1 or 2 and power control sections either as per Schedules 4 and 7, 5 and 8, or 6 and 9.

Power-control sections scheduled with relay protection (Schedules 4 and 7) provide reverse current protection as outlined below under "Operation and Setting of Low-Voltage Release Mechanism." When these sections are used, overload protection for the generator is provided in the overload coils of the auto-starter in the motor circuit. If, for any reason, overload protection for the generator is required on the direct-current side of the motor-generator set, separately mounted fuses or a separately mounted fused-knife switch may be added at an increase in the list price. For overload protection of line, a separately mounted fused knife switch or a carbon circuit-breaker is required if more protection is desired than is afforded by the fuses in the individual charging circuits.

On each of these sections is regularly mounted a battery ammeter, a line or generator ammeter and a voltmeter. The voltmeter may be used to read either line or generator voltage and the voltage of any battery. However, when only one or two charging sections are furnished, a single ammeter can be used in the generator circuit and in the case where two charging sections are furnished, each battery current may be read by opening the other charging circuit. Whenever the battery ammeter is omitted, the holes in the panel are plugged so that the battery ammeter may be added when additional sections are added. If power sections are selected from schedules 4 and 7, the meter section (Schedule 13) is to be omitted.

TYPE SD BATTERY-CHARGING PANELS—Continued

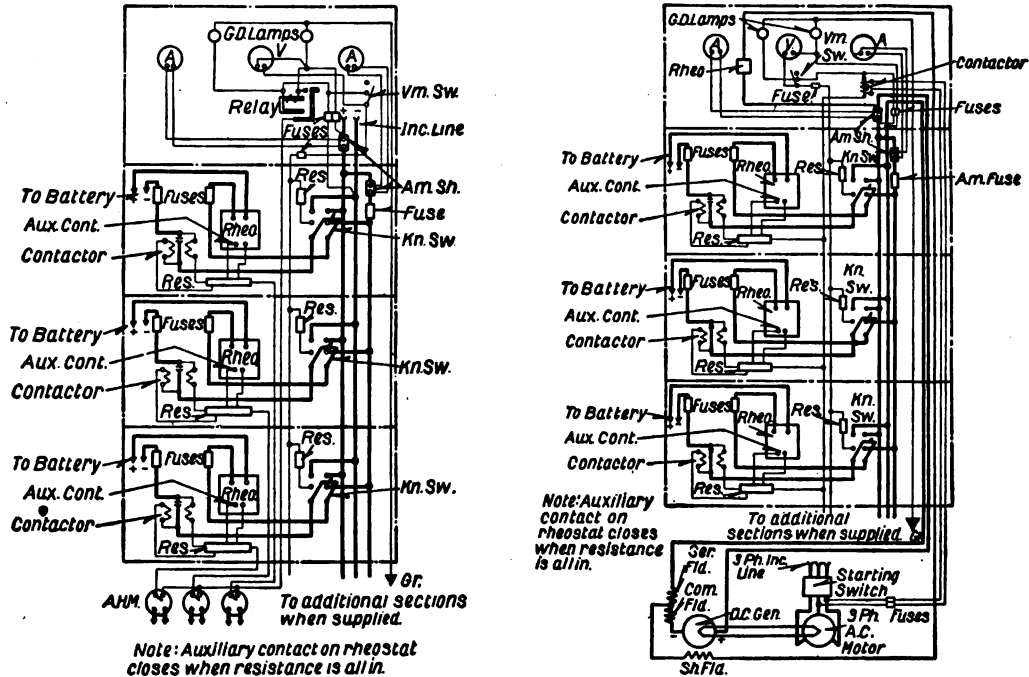
Each charging section is equipped with a special two-pole knife switch which may be moved to a position (without opening the circuit) so that the battery ammeter and voltmeter are connected to the charging circuit, thereby indicating the charging rate in amperes and the voltage of the battery at the same time.

Power-control sections scheduled with circuit-breaker protection (Schedule 5) are regularly furnished with a low-voltage release mechanism, attached to each circuit-breaker to protect the

a-c. low-voltage coils, so that on failure of the a-c. power the low-voltage relay and carbon circuit-breaker will be tripped.

However, when several generators operate in parallel and obtain their power from separate sources it will be necessary to use reverse-current relays, in order to assure absolute protection against the occurrence of reverse current.

From the battery standpoint, it is very desirable to have battery circuits protected against reverse



DIAGRAMS OF TYPICAL CONNECTIONS—WITH CONTACTORS

source of power against reversal of current. When this circuit-breaker opens, due to reversal of current, the auxiliary contacts with which the circuit-breaker is supplied will open all charging circuits which are provided with contactors.

Power-control section (Schedule 8) operates the same as described for Schedule 5, except that the reverse-current protection is provided by means of a type KF relay which opens the carbon circuit-breaker.

In case power-control sections (Schedules 6 and 9) equipped with a fused switch and a low-voltage relay are used, the reversal of current will cause the low-voltage relay to open and thereby open all the charging circuits, if charging sections, Schedule 1, are used.

The low-voltage coil of the carbon circuit-breaker and of the low-voltage relay will be suitable for 115 volts d-c. In case the generators are driven by a-c. induction motors, it is possible to obtain

current. If only the generator or main circuit is protected against reverse current, the batteries remain connected in parallel to the bus-bars (after the circuit-breaker opens). Therefore the batteries having the highest terminal voltage will discharge into the other batteries connected to the system.

**Operation and Setting of Low-Voltage Release Mechanism**—The use of the low-voltage release mechanism, as part of the circuit-breaker equipment, or the use of the low-voltage relay, is adaptable for protection against the reversal of current from a storage battery, because at ordinary temperatures (from 60° to 90° F.) the voltage of a good battery discharging at the normal rate is always lower than the minimum voltage required to start the charging of that battery at the normal starting rate. Furthermore, the charging resistance connected in series with the battery further reduces the voltage across the coil of the circuit-breaker or the low-voltage relay, (upon

TYPE SD BATTERY-CHARGING PANELS—Continued

reversal of battery current), thus assuring the tripping of the breaker or the low-voltage relay.

Since the sections listed are all for use on 115 volt d-c. service only, the low-voltage coils will be adjusted for operation at this voltage. The generator, or source of power, must, therefore, be maintained at approximately a constant voltage of 115 volts d-c.

**Semi-Automatic Battery-Charging Switchboards**

The semi-automatic battery-charging switchboards are composed of the standard type SD battery-charging equipment with the addition of relays for automatically terminating the charge and shutting down the motor which drives the battery charging set. If the batteries have been connected to the charging circuit and are being charged in the regular manner and the operator desires to leave before the charge is completed, it will be possible for him to do so since the semi-automatic equipment will function as follows:

The zero contacts of the amperehour meter, one of which is in each charging circuit, short-circuit the holding-in coil of the battery line contactor when the battery has been charged. This action causes the battery line contactor to drop out, and opens the corresponding circuit. Each battery is cut off successively in a similar manner as it comes up to charge. The tripping of the last charging contactor opens a relay circuit connected to the low voltage coil of the auto starter. The opening of the relay circuit causes the starter to disconnect the motor generator set from the line.

The total equipment may be mounted on a slate base, 12 inches by 11½ inches by 1 inch, which may be attached to the side of the main panel framework. Style numbers are given in Schedule 11.

**Charging Rheostats**

The rheostats scheduled are each designed for the particular number of cells, as indicated. However, each rheostat may be used for charging a battery composed of a slightly larger number of cells, requiring the same charging rate; but it must be ob-

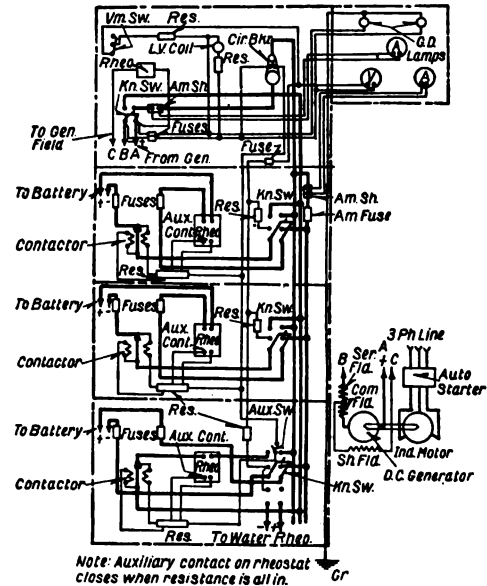
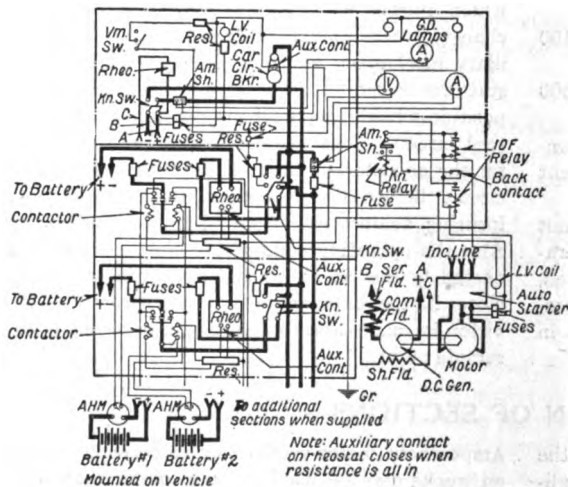
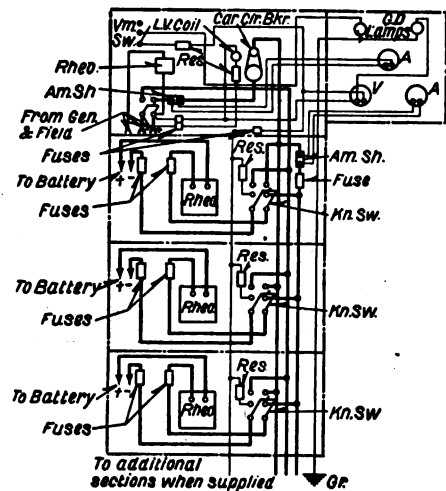


DIAGRAM OF TYPICAL CONNECTIONS WITH CONTACTOR

served that in this case the number of resistance steps available for adjustment will be reduced. If a battery is to be boosted at a rate higher than that scheduled, a special rheostat will be required. For such service complete information should be furnished the Company.



WITH AUTOMATIC EQUIPMENT



WITHOUT CONTACTORS

DIAGRAMS OF TYPICAL CONNECTIONS

## TYPE SD BATTERY-CHARGING PANELS—Continued

For lead batteries, the voltage applied across the battery terminals will be increased as the charge progresses and the charging current will be maintained approximately constant, that is, at the given starting rate until near the end of the charging period; then the current will be reduced to a given finishing rate, and will be maintained approximately

constant throughout the remainder of the charging period.

For nickel-iron (Edison) batteries the voltage applied across battery terminals will be increased as the charge progresses and the charging current will be maintained approximately constant at the required rate.

## ORDERING INSTRUCTIONS

## Style Numbers for Rheostats

The style number for each rheostat includes the resistors with the frames and will be of suitable dimensions for mounting on the charging section. The operating hand wheel is not included in the rheostat style number, but is included in the charging section style number. Charging rheostats as scheduled by style number will be suitable for mounting on any charging section, but care must be exercised so that the charging section is of proper capacity for use with the particular charging rheostat.

## Style Numbers for Sections

The style number of each section includes all wiring and connections mounted on the rear of the section and a proportional amount of vertical copper bars and framework in addition to the apparatus scheduled.

## Horizontal Bus-Bars

When a switchboard consists of two or more panels, there will be required, in addition to the equipment scheduled, a set of horizontal bus-bars comprising positive, negative and ammeter bus-bars. In estimating the amount of bus-bars required for these switchboards, the following values should be used:

One  $\frac{1}{8}$ -inch by 1-inch copper strap will carry 200 amperes direct current.

One  $\frac{1}{8}$ -inch by  $1\frac{1}{2}$ -inch copper strap will carry 300 amperes direct current.

One  $\frac{1}{8}$ -inch by 2-inch copper strap will carry 400 amperes direct current.

One  $\frac{1}{8}$ -inch by 3-inch copper strap will carry 600 amperes direct current.

Two straps of the same dimensions, when connected in parallel, will carry twice the current allowed for one strap of the same dimensions.

Bus-bars between panels ordinarily need not exceed 2 inches in width. However, when generators of more than 400 amperes capacity are used, it is advisable to use 3-inch bus-bars. The ammeter bus-bar need not exceed 1 inch in width in any case.

## SELECTION OF SECTIONS

Outlines are given below which will help in the selection of sections suitable for different conditions under which applications are made. Characteristics of the different combinations are given so that the combination best suited may be selected.

## Data Sheet

Each order for a switchboard should be accompanied by a switchboard data sheet, Form 2724, and with complete information regarding the batteries to be charged. This information should include the following:

Battery maker's name.

Type and number of cells in series.

Number of plates per cell.

Charging rate at start.

Charging rate at finish.

Boosting rate desired.

## Weights

The shipping weight of a panel 90 to 96 inches high, including framework and charging rheostats, will be approximately 1200 pounds.

## Features Provided With the Charging Section

Each charging section is equipped with a special two-pole knife switch which may be moved to a position (without opening the circuit) so that the battery ammeter and voltmeter are connected to the charging circuit, thereby indicating the charging rate in amperes and the voltage of the battery at once.

In addition to the special knife switch for voltmeter and ammeter readings, charging sections provided with a contactor have the following features, which purchasers will find very desirable. The charging rheostat dial plate is provided with auxiliary mechanism which is engaged by the rheostat arm at the "IN," or start position, that is, the position which inserts all the resistance in the battery circuit. This mechanism makes it necessary for the operator to have all charging resistance in circuit before the contactor will close, thereby insuring against an initial high charging current. Also the operating coils of the contactor are connected in the circuit so that the contactor will not close if the battery polarity is reversed. Provision is made also for tripping the circuit from a remote point.

**Amperehour-meter sections or amperehour meters on trucks may be used in any combination which employs charging sections—Schedule 1. They provide automatic termination of charge on each battery.**

## TYPE SD BATTERY-CHARGING PANELS—Continued

**For Generator and Charging Sections**

<b>Combination 1</b>	
Generator Section—Schedule 4.	<b>Features</b>
	Overload protection for generator by auto starter of motor (for motor-generator set). Refer to subject "Automatic Protection."
Charging Sections—Schedule 1.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.
<b>Combination 2</b>	
Generator Section—Schedule 6.	<b>Features</b>
Charging Section—Schedule 1.	Fuse protection for generator.
Meter Section—Schedule 13.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.
<b>Combination 3</b>	
Generator Section—Schedule 5.	<b>Features</b>
Charging Sections—Schedule 1.	Circuit-breaker overload protection for generator.
Meter Section—Schedule 13.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.
<b>Combination 4</b>	
Generator Section—Schedule 5.	<b>Features</b>
Charging Section—Schedule 1.	Circuit-breaker overload protection for generator.
Meter Section—Schedule 13.	Fuse protection for battery.
Semi-Automatic Equipment—Schedule 11.	Reverse current protection. Protection against wrong connection to battery.
Amperehour-meter Section—Schedule 12. (Or use amperehour meters supplied with trucks).	Automatic termination of charge on each battery. Automatic shut-down of motor-generator set on completion of charge on all batteries.
<b>Combination 5</b>	
Generator Section—Schedule 4.	<b>Features</b>
	Overload protection for generator by auto starter for motor (for motor-generator set). Refer to subject "Automatic Protection."
Charging Sections—Schedule 1.	Fuse protection for battery.
Semi-Automatic Equipment—Schedule 11.	Reverse current protection.
Amperehour-meter Section—Schedule 12. (Or use amperehour meters supplied with trucks.)	Protection against wrong connection to battery. Automatic termination of charge on each battery. Automatic shut-down on motor-generator set on completion of charge on all batteries.

**For Incoming Line and Charging Sections**

<b>Combination 6</b>	
Line Section—Schedule 10.	<b>Features</b>
Charging Sections—Schedule 2.	Fuse protection for line.
Meter Section—Schedule 13.	Fuse protection for battery.
<b>Combination 7</b>	
Line Section—Schedule 9.	<b>Features</b>
Charging Sections—Schedule 1.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.
<b>Combination 8</b>	
Line Section—Schedule 7.	<b>Features</b>
Charging Sections—Schedule 1.	Fuse protection for line (supplied by customer if desired).
Meter Section—Schedule 13.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.
<b>Combination 9</b>	
Line Section—Schedule 8.	<b>Features</b>
Charging Sections—Schedule 1.	Circuit-breaker overload protection for line.
Meter Section—Schedule 13.	Fuse protection for battery. Reverse current protection. Protection against wrong connection to battery.

**Special Sections**

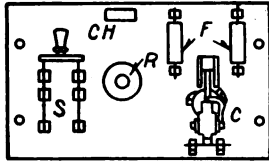
It is urged that sections be selected from those scheduled because drilling templates, permanent manufacturing information and a stock of parts are available for such sections and, therefore, better delivery can be made.

TYPE SD BATTERY-CHARGING PANELS—Continued

CHARGING SECTIONS

With Magnetically-Operated Switch or Contactor

Schedule 1



One section, 14 by 24 by 1 inches.

One knife switch (S) two-pole single-throw with intermediate voltmeter and ammeter jaws.

One contactor (C) with blowout and operating coils.

\*One operating hand wheel for charging rheostat (R).

Two enclosed fuses (F).  
One card holder (CH).

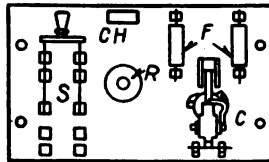
Necessary copper connections and wiring on rear.

\*Charging resistor not included. Select charging resistor from page on "Battery-Charging Resistors."

Capacity Amperes	Style No.	List Price
50	361529	\$105 00
75	361530	115 00
100	361531	120 00
200	361532	135 00

With Magnetically-Operated Switch or Contactor with Charge and Discharge Switch

Schedule 2



One section, 14 by 24 by 1 inches.

One knife switch (S) two-pole double-throw with intermediate voltmeter and ammeter jaws.

One contactor (C) with blowout and operating coils.

\*One operating hand wheel for charging rheostat (R).

Two enclosed fuses (F).  
One cardholder (CH).

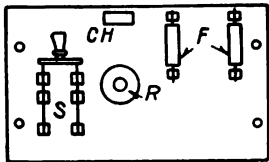
Necessary copper connections and wiring on rear.

\*Charging resistor not included. Select charging resistor from page on "Battery-Charging Resistors." Discharge resistor must be a water rheostat made by purchaser or will be made up special.

Capacity Amperes	Style No.	List Price
50	308205	\$115 00
75	361533	125 00
100	308206	135 00
200	308207	150 00

Without Magnetically-Operated Switch or Contactor

Schedule 3



One section, 14 by 24 by 1 inches.

One knife switch (S) two-pole single-throw with intermediate voltmeter and ammeter jaws.

\*One operating handle for charging rheostat (R).  
Two enclosed fuses (F).

One cardholder (CH).

Necessary copper connections and wiring on rear.

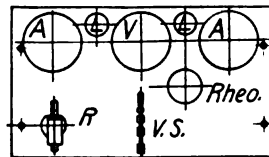
\*Charging resistor not included. Select charging resistor from page on "Battery-Charging Resistors."

Capacity Amperes	Style No.	List Price
50	361534	\$ 92 00
75	361535	98 00
100	361536	98 00
200	361537	110 00

GENERATOR SECTIONS

Combination Generator and Meter Section—With Reverse Current Relay Protection

Schedule 4



One section 14 by 24 by 1 inches.

One generator ammeter (A), type DX.

One battery ammeter (A), type DX.

One voltmeter (V), type DX, 150 volt scale.

One relay (R).

One voltmeter switch (V.S.).

One drilling for rheostat mounting (Rheo.)

Two ground detector lamps (L).

Necessary copper connections and wiring on rear.

Cap. Amperes	Gen. Ammeter Scale	Battery Ammeter Scale	Style Number	List Price
60	100	100	306868	\$175 00
100	150	100	306869	175 00
200	300	200	306870	175 00
300	500	200	306871	180 00
400	600	200	306872	180 00
600	1000	200	306873	190 00
800	1200	200	306874	190 00

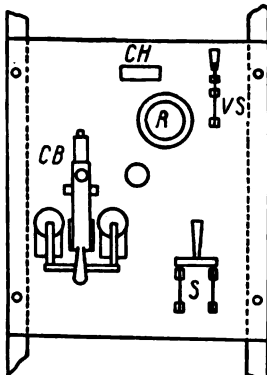
Order by Style Number



**TYPE SD BATTERY-CHARGING PANELS—Continued**

**GENERATOR SECTIONS—Continued**

**With Circuit-Breaker Protection  
Schedule 5**



One section, 28 by 24 by 1 inches.

One circuit-breaker (CB), type CL, with low voltage release attachment and auxiliary contact.

One knife switch (S), two-pole, single-throw, 250-volt.

One drilling for rheostat mounting, (R).

One voltmeter switch (VS).

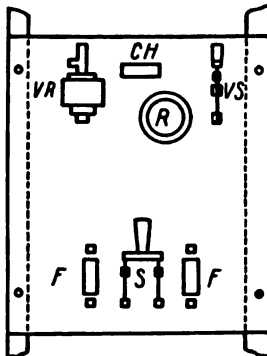
One ammeter, type DX, and shunt. Ammeter mounted on meter section at side of board.

One cardholder (CH).

Necessary connections and wiring on rear.

Capacity Amperes	Ammeter and Shunt—Amp.	Style No.	List Price
60	100	381538	\$205 00
100	150	381539	205 00
200	300	381540	210 00
300	500	381541	295 00
400	600	381542	295 00
600	1000	381543	300 00
800	1200	381544	305 00

**With Fused Switch and with Low-Voltage Relay Protection  
Schedule 6**



One section, 28 by 24 by 1 inches.

One knife switch (S), two-pole, single-throw, 250-volt.

Four enclosed fuse holders (F) 250 volt.

Two enclosed fuses (F).

One drilling for rheostat mounting (R).

One voltmeter switch (VS).

One cardholder (CH).

One ammeter, type DX, and shunt. Ammeter mounted on meter section at side of board.

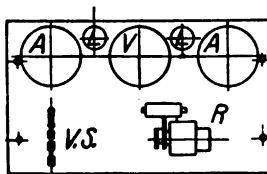
One low voltage relay (VR).

Necessary connections and wiring on rear.

Capacity Amperes	Ammeter and Shunt—Amp.	Style No.	List Price
60	100	279481	\$145 00
100	150	279482	150 00
200	300	279483	155 00
300	500	279484	180 00
400	600	279485	180 00
600	1000	279486	200 00

**LINE SECTIONS**

**Combination Line and Meter Section—With Reverse Current Relay Protection  
Schedule 7**



One section, 14 by 24 by 1 inches.

One line ammeter (A), type DX.

One battery ammeter (A), type DX.

One voltmeter (V), type DX, 150 volt scale.

One relay (R), type KF.

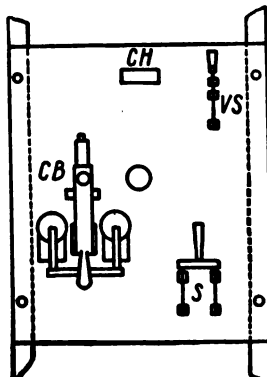
One voltmeter switch (VS).

Two ground detector lamps (L).

Necessary copper connections and wiring on rear.

Cap. Amperes	Line Ammeter Scale	Battery Ammeter Scale	Style Number	List Price
60	100	100	308875	\$180 00
100	150	100	308876	180 00
200	300	200	308877	180 00
300	500	200	308878	185 00
400	600	200	308879	185 00
600	1000	200	308880	190 00
800	1200	200	308881	190 00

**With Circuit-Breaker Protection  
Schedule 8**



One section, 28 by 24 by 1 inches.

One circuit-breaker (CB), type CL, with low-voltage release attachment and auxiliary contact.

One knife switch (S), two-pole, single-throw 250-volt.

One relay, type KF.  
One voltmeter switch (VS).

One ammeter, type DX, and shunt. Ammeter mounted on meter section at side of board.

One cardholder (CH).

Necessary connections and wiring on rear.

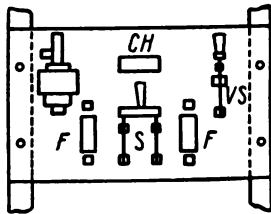
Capacity Amperes	Ammeter and Shunt Amperes	Style No.	List Price
60	100	381545	\$225 00
100	150	381546	230 00
200	300	381547	230 00
300	500	381548	315 00
400	600	381549	315 00
600	1000	381550	320 00
800	1200	381551	325 00

TYPE SD BATTERY-CHARGING PANELS—Continued

LINE SECTIONS—Continued

With Fused Switch and Low-Voltage Relay Protection

Schedule 9



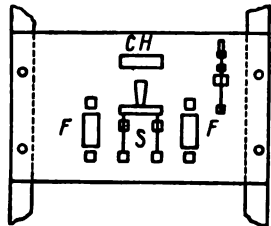
One section (see table for dimensions).  
 One knife switch (S), two-pole, single-throw, 250-volt.  
 Two enclosed fuses (F).  
 One voltmeter switch (VS).

One cardholder (CH).  
 One ammeter, type DX, and shunt. Ammeter mounted on meter section at side of board.  
 One low-voltage relay.  
 Necessary connections and wiring on rear.

Capacity Amperes	Ammeter and Shunt Amperes	Slab	Style No.	List Price
60	100	14 x 24 x 1	279500	\$125 00
100	150	14 x 24 x 1	279501	130 00
200	300	28 x 24 x 1	279502	155 00
300	500	28 x 24 x 1	279503	175 00
400	600	28 x 24 x 1	279504	175 00
600	1000	28 x 24 x 1	279505	200 00

With Fused Switch Protection Only

Schedule 10



One section, 14 by 24 by 1 inches.  
 One knife switch (S), two-pole, single-throw, 250-volt.  
 Four enclosed fuses (F).  
 One voltmeter switch (VS).

One ammeter, type DX, and shunt. Ammeter mounted on bracket at side of board.  
 One cardholder (CH).  
 Necessary connections and wiring on rear.

Capacity Amperes	Ammeter and Shunt Amperes	Style No.	List Price
60	100	279506	\$105 00
100	150	279507	120 00
200	300	279508	130 00
300	500	279509	140 00
400	600	279510	140 00
600	1000	279511	160 00

SEMI-AUTOMATIC EQUIPMENT

Schedule 11



In order to embody the automatic features as described under the paragraph "Semi-Automatic Battery Charging Switchboards," it is necessary to supply with each

charging section, one set of interlocks, and one ampere hour meter, also one relay section (Style No. 308208 or Style No. 308209) is required for each generator section.

The necessary amperehour meters are not included in Schedule 11, and are either mounted on battery trucks or on amperehour-meter sections, Schedule 12.

One set of Interlocks.\*

\*Order one set for each charging section. List price \$10.00.

One Section 11 by 12½ by 1 inches.  
 One relay with interlocks.  
 One relay, type KN.

Section* Style No.	List Price
308208	\$70 00
*Order one for use with each generator section. Schedule 4. Specify voltage and frequency of motor circuit.	

This section is the same as Style No. 308208 with the addition of one relay without interlocks.

Section* Style No.	List Price
308209	\$85 00
*Order for use with generator sections, Schedules 5 and 6. Specify voltage and frequency of motor circuit.	

Order by Style Number

TYPE SD BATTERY-CHARGING PANELS—Continued

AMPEREHOUR METER SECTIONS

Schedule 12

One section 14 by 24 by 1 inches.

Drilling for three amperehour meters, auto type, complete with zero contact, reset device, and variable resistor element.

Necessary connections and wiring on rear.

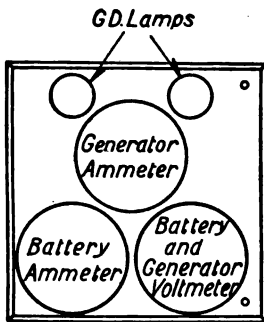
Capacity Amperes	Drilling For	*Style No.	List Price
30 to 200	One Amperehour Meter	279512	\$18 50
30 to 200	Two Amperehour Meters	279513	21 00
30 to 200	Three Amperehour Meters	306705	23 50

NOTE:—Plugs will be provided for extra drillings when less than three amperehour meters are required.  
\*Style No. does not include amperehour meters.

In ordering amperehour meter sections state capacity and amperehour calibration desired.

METER SECTIONS

Schedule 13



One section 11 by 12½ by 1 inches, for mounting on side of panel.

One voltmeter, type DX, 0-150 volt scale.

One drilling only for generator or line ammeter, type DX. Meter is supplied with generator or line section.

One battery ammeter, type DX, as per schedule.

Two ground detector lamps.

Necessary copper connections and wiring on rear.

Battery Ammeter Amperes	Style No.	List Price
50	306882	\$95 00
75	306883	95 00
100	306884	95 00
150	306885	95 00
200	306886	95 00

BLANK SECTIONS

For multi-panel switchboards, in order to provide panels of uniform height, and to provide for the insertion of future charging sections, blank sections should be ordered. Four mounting bolts are included.

Height Inches	Width Inches	Thickness Inches	Bevel Inches	List Price
14	24	1	¼	\$ 8 00
28	24	1	¼	14 00

BATTERY CHARGING RESISTORS

For 40 to 44 Lead Cells

For 60 to 62 Edison Cells at Normal Rate

CHARGING RATE AMPERES			Style No.	List Price
Maximum	Minimum	Ohms in Resistor		
12	5	3.05	381552	\$19 00
14	6	2.53	381553	19 00
17	7	2.16	381554	27 00
19	8	2.16	381554	27 00
24	10	1.5	381555	27 00
30	12	1.5	381555	27 00
35	14	1.03	381556	27 00
40	16	1.03	381556	27 00
45	18	.89	381557	27 00
51	20	.74	381558	28 00
56	22	.74	381558	28 00
61	24	.64	381559	31 00
66	26	.64	381559	34 00
68	30	.76	381580	38 00

CHARGING RATE AMPERES			Style No.	List Price
Maximum	Minimum	Ohms in Resistor		
22½	.....	1.06	381561	\$20 00
30	.....	1.06	381561	20 00
37½	.....	.70	381562	21 00
45	.....	.56	381563	21 00
52½	.....	.48	381564	28 00
60	.....	.48	381564	28 00
67½	.....	.385	381565	28 00
75	.....	.35	381566	28 00
82½	.....	.30	381567	28 00
90	.....	.30	381567	29 00
105	.....	.24	381568	51 00
135	.....	.19	381569	56 00
45	22½	1.06	381570	28 00
60	30	.81	381571	32 00
75	37½	.67	381572	33 00
90	45	.56	381573	38 00
105	52½	.48	381574	68 00
120	60	.43	381575	68 00
135	67½	.385	381576	68 00
150	75	.33	381577	68 00

Order by Style Number

# TYPE KS BATTERY-CHARGING SWITCHBOARDS

## BATTERY-CHARGING SWITCHBOARDS FOR LARGE GARAGES AND SERVICE STATIONS

### SECTIONAL TYPE

These switchboards are designed to meet requirements for charging small automobile batteries in large garages and service stations. Provision is made for charging from motor-generator sets or from D-C. incoming lines.

As incoming lines usually have a voltage in excess of that required to charge the battery, the charging rheostats are of suitable design to take care of the difference between the line voltage and the voltage required for charging.

Each rheostat is suitable for charging a battery or a number of batteries connected in series, comprised of from 3 cells to the maximum number permitted by the charging voltage available. This number of cells is, 30 at 80 volts, 36 at 100 volts, 39 at 110 volts and 45 at 125 volts. The rheostats are suitable for charging at rates varying between 3 and 12 amperes.

A switchboard for charging automobile batteries is composed of one generator section and as many charging sections as desired. Each charging section is designed to take care of two circuits and any number of battery sections may be used in connection with a power control section of suitable capacity. Each panel will be made up of not

more than 4 sections. When more charging circuits are required, sections will be mounted on framework forming two or more panels.

The switchboards are mounted on type K 3/4-inch pipe framework 64 inches in height.

Each charging circuit is protected against reversal of current and has fuse overload protection. Charging current may be read on any battery by means of an ammeter switch which is provided for each charging circuit. This switch is also used to disconnect one side of the battery from the generator or incoming line. Power-control sections are designed for capacities ranging from 30 to 270 amperes and voltage from 80 to 125 volts. Overload fuse protection is provided. Reverse current protection is provided on the generator control section by the opening of a relay which operates from the motor circuit. On the incoming line section, or when a D-C.-D-C. motor-generator set is used, a reverse current relay is provided which opens all charging circuits on reversal of current due to line voltage failure.

Switches for disconnecting the switchboard from the generator or incoming line are not provided. If required, separately-mounted switches should be furnished.

### GENERATOR SECTIONS

#### SCHEDULE A

##### Schedule of Apparatus

One panel 14 by 24 by 1 inches.

One battery ammeter, type CX, 25 ampere scale.

One generator ammeter type CX.

One contactor type 10-F (Relay).

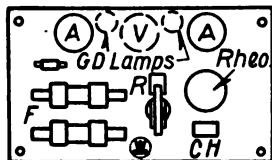
For a-c.-d-c. motor-generator set only.

One relay type KF. For d-c.-d-c. motor-generator set only.

Two enclosed fuses. One ammeter fuse.

One drilling for generator field rheostat. One cardholder.

Necessary copper connections and wiring on rear.



Capacity Amperes	Motor	Generator Ammeter Scale	Fuses Amps.	Style No.	List Price
30	A.C.	50	40	308186*	\$115 00
60	A.C.	100	75	308187*	125 00
100	A.C.	150	125	308188*	125 00
150	A.C.	200	175	308189*	125 00
200	A.C.	300	250	308190*	140 00
270	A.C.	400	350	308191*	145 00
30	D.C.	50	40	308192†	120 00
60	D.C.	100	75	308193†	125 00
100	D.C.	150	125	308194†	130 00
150	D.C.	200	175	308195†	130 00
200	D.C.	300	250	308196†	145 00
270	D.C.	400	300	308197†	150 00

\*Specify voltage and frequency of motor circuit.  
 †Specify voltage of motor circuit.  
 Optional: The addition of a voltmeter, type CX, and ground detector lamps at an increase in list price of \$20.00 and \$5.00 respectively.  
 Omission: Generator ammeter at a decrease in list price of \$15.00.

Order by Style Number

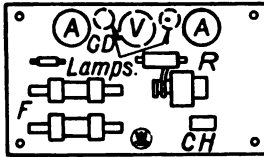
TYPE KS BATTERY-CHARGING SWITCHBOARDS—Continued

DIRECT CURRENT INCOMING LINE SECTIONS  
SCHEDULE B

Schedule of Apparatus

One panel, 24 by 14 by 1 inches.

Necessary copper connections and wiring on rear.



One battery ammeter, type CX, 25 ampere scale.

One line ammeter, type CX.

One relay, type KF.

Two enclosed fuses.

One ammeter fuse.

Card holder (CH).

Capacity Amperes	Line Ammeter Scale	Fuses Amperes	Style Number	List Price
30	50	40	308198	\$120 00
60	100	75	308199	125 00
100	150	125	308200	130 00
150	200	175	308201	130 00
200	300	250	308202	145 00
270	400	350	308203	150 00

Optional: The addition of a voltmeter, type CX, and ground detector lamps at an increase in list price of \$20.00 and \$5.00 respectively.

Omission: Line ammeter at a decrease in list price of \$15.00

CHARGING SECTION  
SCHEDULE C

Schedule of Apparatus

One panel, 14 by 24 by 1 inches.

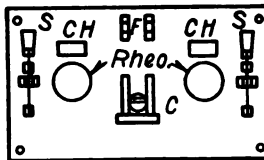
Two battery charging rheostats (Rheo.)

One contactor (C), type 12-C, two-pole.

Two knife switches, with auxiliary jaws for connecting battery ammeter in charging circuits (S).

Two enclosed fuses (F).

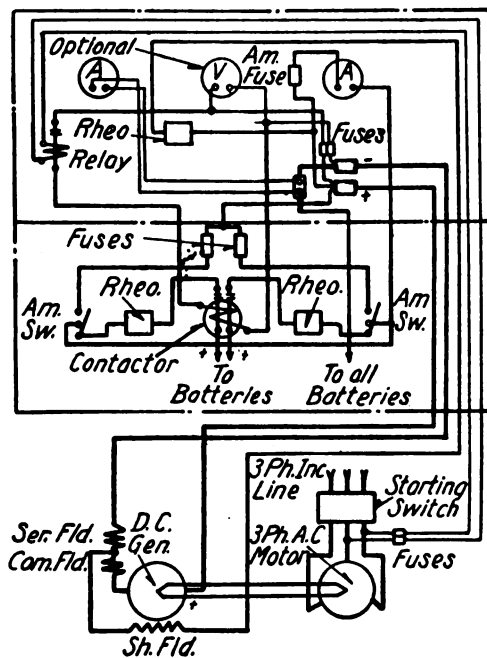
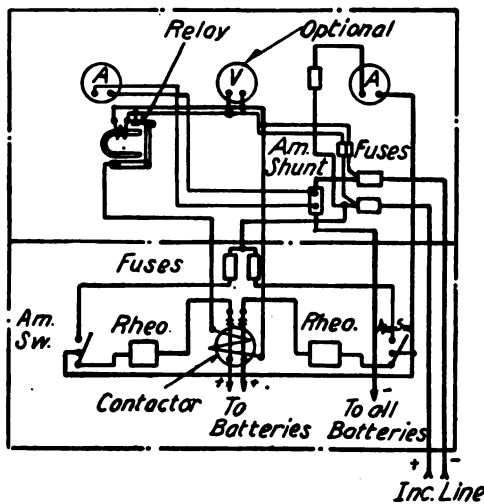
Necessary copper connections and wiring on rear.



Two card holders (CH).

Capacity Amperes	Ammeter Scale	Fuse Amperes	Style Number	List Price
15	20	20	308204	\$185 00

Diagrams for Battery-Charging Switchboards for Large Garages and Service Stations



Order by Style Number

# TYPE KD-1 BATTERY-CHARGING SWITCHBOARDS

## 35 to 125 VOLTS D-C. SERVICE

### For Charging From 24 to 70 Edison Cells or 16 to 48 Lead Cells in Series

Where only one battery is to be charged at a time and when automatic termination of charge is desired, the expense of a complete type SD battery-charging switchboard is not warranted; therefore, a switchboard incorporating the principal SD features has been designed so that the superior qualities of the more expensive board may be had.

All types of panels are automatic in their opera-

tion and have overload fuse protection, low voltage and reverse-current protection, as well as automatic shut-down of motor-generator set or disconnection from incoming line on completion of charge.

These switchboards are mounted on type K  $\frac{3}{4}$ -inch pipe framework 64 inches in height.

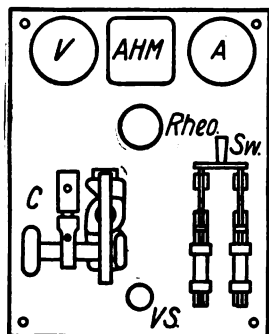
### FOR CHARGING EDISON BATTERIES

The constant current (differentially-compound wound) generator is the most suitable source of power for charging Edison cells, and standard panels for the control of these generators and one charging circuit have been developed. However, in many cases, there is a standard shunt or compound wound generator available which can be used by frequent adjustments of the generator field rheostat. Panels have also been designed to control an incoming line

and one circuit for charging. A rheostat is placed in the charging circuit to secure the proper charging rate. For installations where an attendant is not available during the charging period, the rheostat can be set on a suitable point and used as a fixed resistance for charging by the modified constant potential or fixed resistance method of charge.

#### Switchboard for Control of Constant-Current and Constant-Potential Generators for Charging Edison Batteries

##### Schedule of Apparatus



One panel 20 by 25 by 1 inches.

One voltmeter (V), type CX.

One ammeter (A), type CX.

\* One ampere-hour meter (AHM), Sangamo type MS, for opening circuit on completion of charge.

One drilling for generator field rheostat (Rheo).

One fused knife switch (SW), two-pole

One relay (C), type F.

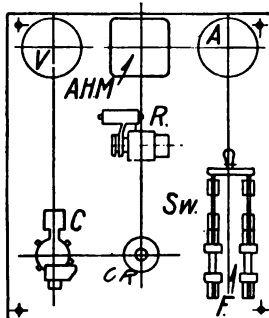
One voltmeter switch (VS).

Necessary copper connections and wiring on rear.

Capacity Amp.	Ammeter Scale	Amp. Hr. Meter	Allowance Dial of for Omission of AHM*	Style No.	List Price
30	75	200	\$4 00	308210	\$205 00
60	150	400	6 00	308211	210 00
100	200	800	9 00	308212	226 00

#### Switchboard for Control of an Incoming Line for Charging Edison Batteries

##### Schedule of Apparatus



One panel 24 by 28 by 1 inches.

One voltmeter (V), type CX.

One ammeter (A), type CX.

\* One ampere-hour meter (AHM), Sangamo type MS.

One relay (R), type KF.

One contactor (C), type C.

One fused knife switch (SW), two-pole.

† One operating hand wheel for battery-charging rheostat (CR).

Necessary copper connections and wiring on rear.

Capacity Amp.	Ammeter Scale	Amp. Hr. Meter	Allowance Dial of for Omission of AHM*	Style No.	Section List Price
30	75	200	\$4 00	308216	\$240 00
60	150	400	6 00	308217	255 00
100	200	800	9 00	308218	270 00

\*If the Sangamo ampere-hour meter is mounted on truck or locomotive or in some other position and not required on panel it may be omitted at a reduction in list price as given in the table. When the ampere-hour meter is omitted, an additional relay, type KN, is required.

†Battery-charging rheostat not included in style number. Select rheostat from section covering type SD charging panels.

Order by Style Number

2-178 B

TYPE KD-1 BATTERY-CHARGING SWITCHBOARDS—Continued

FOR CHARGING LEAD BATTERIES

Apparatus for the charging of lead batteries is designed to give a high starting rate for boosting purposes and automatically reduces the current to a low non-gassing finishing rate when the battery voltage at completion of charge closely approximates the charging voltage. The "modified-constant voltage" method of charging recommended by lead battery manufacturers, as being the most desirable for lead batteries, consists of a constant potential source with a fixed resistance in each charging circuit or the equivalent, a separate direct current source with suitable drooping characteristics for each circuit. This method of charge is a compromise between the constant current and constant potential charging methods, and has the advantages, in addition to its simplicity and convenience, of permitting the battery to be charged in minimum time with the least injurious results to the battery.

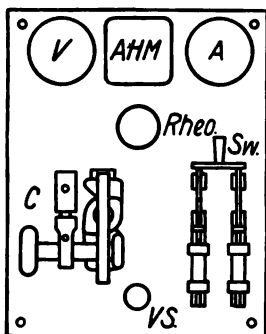
These switchboards are built in line with recommendations of Battery Manufacturers. They incorporate the principal automatic features of the

type SD switchboards and the switchboards for charging Edison batteries, viz., low-voltage and reverse-current protection, overload fuse protection, as well as the automatic shut-down of motor-generator set or disconnection of battery from incoming line on completion of charge. Only one battery of from 12 to 48 cells can be charged at a time, as is the case with the switchboard for charging Edison batteries.

Switchboards for the control of generators for charging lead batteries are designed so that the adjustment of generator voltage determines the rate of charge. For the incoming line, a battery-charging rheostat is required if more than one type of battery is to be charged. In this case, a standard panel for charging an Edison battery from an incoming line is modified by the insertion of the permanent resistance step in the charging rheostat. The panel for automatic charging of lead batteries is essentially the same as the panel for charging Edison batteries from a constant-current generator with the permanent resistor added.

Switchboards for Control of Generators for Charging Lead Batteries

Schedule of Apparatus



- One panel 20 by 25 by 1 inches.
- One voltmeter (V), type CX.
- One ammeter (A), type CX.
- \* One amperehour meter (AHM), Sangamo type MS.
- One drilling for generator field rheostat.

- One fused knife switch (SW), two-pole.
- One voltmeter switch (VS).
- One contactor (C), type F.

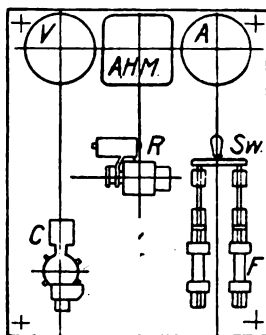
†One resistor.

Necessary copper connections and wiring in rear.

Capacity Amp.	Ammeter Scale	Amp. Hr. Dial of Meter	Allowance for Omission of AHM*	Style No.	List Price
30	75	200	\$4 00	308219	\$185 00
60	150	400	6 00	308220	195 00
100	200	800	9 00	308221	210 00

Switchboards for Control of Incoming Line for Charging Lead Batteries

Schedule of Apparatus



- One panel 20 by 25 by 1 inches.
- One voltmeter (V), type CX.
- One ammeter (A), type CX.
- \* One amperehour meter (AHM), Sangamo type MS.
- One relay (R), type KF.

- One contactor (C), type C.
- One fused knife switch (SW), two-pole.
- †One resistor.

Necessary copper connections and wiring in rear.

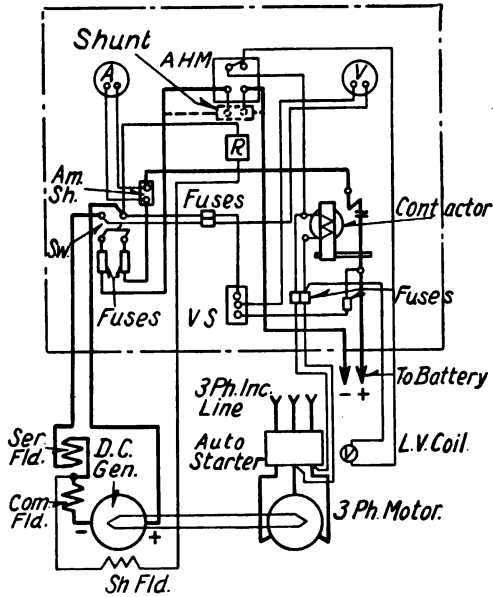
Capacity Amp.	Ammeter Scale	Amp. Hr. Dial of Meter	Allowance for Omission of AHM*	Style No.	List Price
30	75	200	\$4 00	308222	\$225 00
60	150	400	6 00	308223	240 00
100	200	800	9 00	308224	255 00

\*If the Sangamo amperehour meter is mounted on truck or locomotive or in some other position and not required on panel, it may be omitted at a reduction in list price as given in the table. When the amperehour meter is omitted, an additional relay, type KN, is required.  
 †Resistance unit not included in style number.

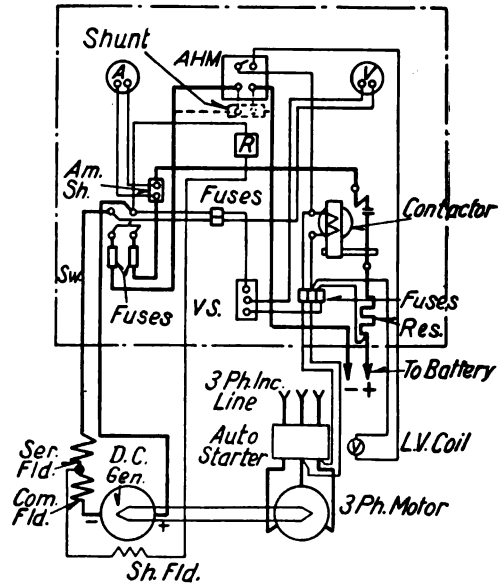
Order by Style Number

TYPE KD-1 BATTERY-CHARGING SWITCHBOARDS—Continued

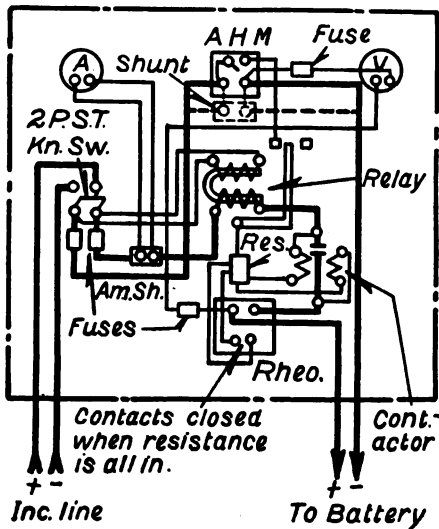
DIAGRAMS OF CONNECTIONS FOR AUTOMATIC CHARGING OF EDISON AND LEAD CELLS



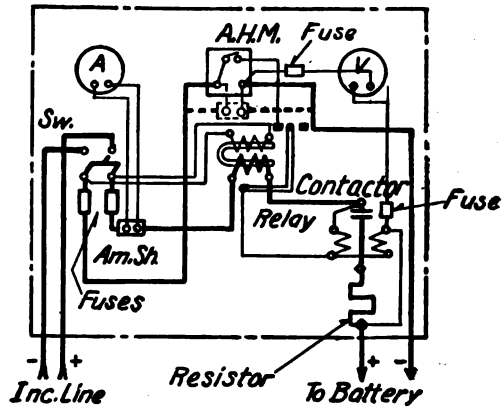
CHARGING AN EDISON BATTERY FROM A CONSTANT CURRENT OR A CONSTANT POTENTIAL GENERATOR



CHARGING A LEAD BATTERY FROM A CONSTANT POTENTIAL GENERATOR



CHARGING AN EDISON BATTERY FROM AN INCOMING LINE



CHARGING A LEAD BATTERY FROM AN INCOMING LINE

NOTE.—When shunt is supplied with AHM, use dotted connection and omit corresponding solid line connection.



## TYPE JA A-C. SWITCHBOARD PANELS

240-480 VOLTS—TWO-AND-THREE-PHASE—60-CYCLE

**Application**—The type JA switchboards are particularly designed for the control of from one to three generators in small industrial plants and central stations operating alternating-current systems below 500 volts.

**Capacity**—The capacity of a single generator panel is limited to 600 amperes, and that of a complete switchboard composed of these panels, to 1800 amperes, with the number of panels limited to five. For greater capacities, a switchboard composed of type EA panels is recommended.

**Panel Construction**—Each panel consists of a single section, 48 inches high by 16 inches wide, (20 inches wide for two-phase)  $1\frac{1}{2}$  inches thick, with  $\frac{1}{4}$  inch bevels on front edges. As indicated by the type letter J, each panel is mounted on a type J  $1\frac{1}{4}$ -inch pipe frame. The total height of the panel is 76 inches.

**Automatic Protection**—No overload protection is provided for the main or field circuits of alternating-current generators. The panels for feeder circuits include one set of enclosed fuses.

**Apparatus**—Ammeters and voltmeters are type SY; knife switches and field switches are type A; and instrument switches are type RS. The field switches are mounted on the rear of the generator panels, with the operating handles on the front.

**Field Rheostats**—The generator panels are designed to have the exciter and generator rheostats separately mounted and operated by a remote control mechanism.

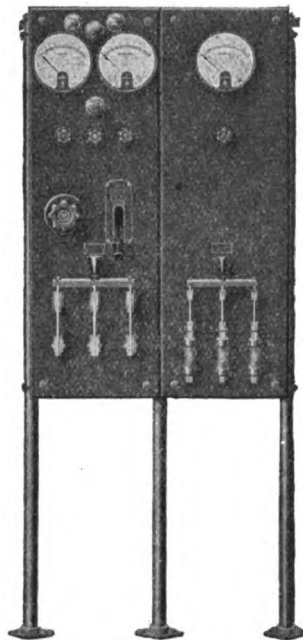
The handwheels for operating the rheostats are concentric and are operated from the front of the panels. The rheostats and rheostat-operating mechanisms are not included with the panels as they are generally furnished with the machines. If desired, the rheostat-operating mechanism can be furnished at an increase in cost; specify double-handle remote-control rheostat mounting Style No. 290894 from section 2-B, "Switchboard Details."

**Synchronizing**—Type JA panels are designed for synchronizing between the incoming machine and the bus-bars. A rotary type synchronizing switch and an incandescent lamp are furnished with each generator panel and one removable synchronizing switch handle is supplied with each switchboard.

A synchronoscope mounted on a swinging bracket with the necessary voltage transformers mounted on the rear of the panels can be supplied, if desired, at an additional price.

**Exciter Panels**—Each generator panel is designed to have the generator field connected through a two-pole switch with field-discharge contact to a single exciter. If parallel operation of exciters is desired, exciter panels should be ordered.

**Alterations from Standard Panels Listed**—Three-phase 60-cycle panels are listed. Two-phase panels



TYPE JA SWITCHBOARD PANELS

are special and inquiries regarding them should be referred to the Company.

Generator or feeder panels can be supplied for 25-cycle service without change in price. In ordering these panels, order the 60-cycle style number and specify for 25 cycles.

A generator field ammeter or a polyphase wattmeter may be added to the generator panels. When either is added to a generator panel having a voltmeter, the voltmeter is mounted on a swinging bracket at the side of the panel, and the added instrument takes its place on the panel.

**Data Sheet**—Each order for a switchboard should be accompanied by a Switchboard Data Sheet, Form No. 2724, completely filled out. Full information given at the time of entering order prevents unnecessary correspondence and delay in shipment.

**Shipment**—Any one of the panels listed herein can be shipped within 15 days after receipt of order at the Works, with full and complete information and Data Sheet properly filled out. However, any change or substitution of apparatus as listed by style number will necessitate obtaining a new delivery promise from the Company.

Panel style numbers include the frame, wall brace ends, the panel with apparatus mounted thereon according to schedules given, and necessary details and connections on the rear for operating a single panel.

**Bus-bars** when required, must be ordered separately.

See also Instructions for Ordering.

TYPE JA A-C. SWITCHBOARD PANELS—Continued

**Voltage Readings**—On any of the generator panels, provision can be made, if desired, to read voltage across any phase, at an increase in list price of \$7.00.

**Additional Feeder Panels**—Any of the type JD, 2-wire feeder panels listed in this catalogue may be adapted for the control of single-phase feeders by simply altering the bus connections.

In ordering these panels for single-phase feeder service, specify as follows: "Single-phase feeder panel, similar to style No..... but adapted for type JA switchboard, (two or three) phase, (240 or 480) volts."

**Sub-Sections for Watthour Meters**—The following style numbers include black marine section with mounting brackets and bolts, for mounting on type J frame immediately below the main section, and drilling for a polyphase type OA switchboard-mounting, glass-cover watthour meter, together with brackets for meter transformers and necessary wiring. The meter and transformers are not included.

Size of Sub-Section, Inches	Panel Style No.	List Price
16x28x1½	306474	\$31 00
20x28x1½	306475	34 00
24x28x1½	306476	38 00

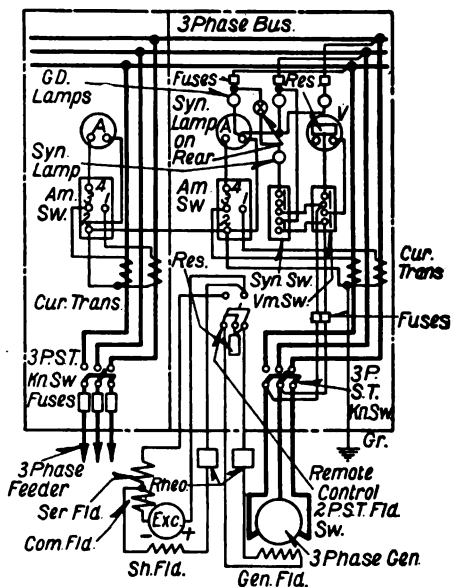


DIAGRAM OF TYPICAL CONNECTIONS

**THREE-PHASE GENERATOR PANELS**  
240-480 Volts, 60 Cycles  
SCHEDULE A

Using One Ammeter With Ammeter Switch

For control of one generator, panel Fig. 1 should be ordered with the first machine installed, and Fig. 2 with the second and each succeeding machine.

**Schedule of Apparatus**

- One panel, 16 inches wide.
- One ammeter, type SY.
- \*One voltmeter, type SY.
- One voltmeter switch, type RS, double-pole with removable\* handle.
- One ammeter switch, type RS, three-phase for reading current in each phase.
- One drilling only for Westinghouse double-hand wheel, remote-control rheostat mounting.
- One synchronizing switch, type RS, with removable \*handle.
- One synchronizing lamp.
- \*One lamp ground detector outfit. (A push button is included for 480 volts only.)
- One cardholder.
- One knife switch, type A, three-pole, single-throw.
- One field-discharge switch, type A, two-pole, single-throw, remote-control mounted on rear of panel with operating handle on the front.
- One mounting only for field-discharge resistor.
- Two current transformers, type K, for use with ammeter.

\*With panel Fig. 1 only.

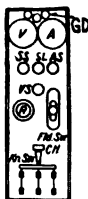


FIG. 1

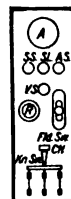


FIG. 2

**For 240 Volts**

Generator Cap. Kva. (Max. Continuous.)	Ammeter Scale	Current Trans. Pri. Amps. (5 Amp. Secondary)	Ampere Capacity of Switch	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
				Panel Style No.	Individual Operation	Bus-Bar Operation	Panel Style No.	Individual Operation	Bus-Bar Operation
25	75	75	60	357378	\$415 00	\$425 00	357388	\$365 00	\$375 00
37.5	120	100	100	357379	420 00	430 00	357389	370 00	380 00
50	150	150	200	357380	430 00	440 00	357390	380 00	390 00
62.5	200	200	200	357381	435 00	445 00	357391	385 00	395 00
75	250	200	200	357382	440 00	450 00	357392	390 00	400 00
100	300	300	400	357383	450 00	465 00	357393	400 00	415 00
125	400	400	400	357384	455 00	470 00	357394	405 00	420 00
150, 156	500	500	400	357385	460 00	475 00	357395	410 00	425 00
175 to 200	600	500	600	357386	475 00	495 00	357396	425 00	445 00
225 to 250	750	750	600	357387	485 00	505 00	357397	435 00	455 00

(Continued on next page)

Order by Style Number

TYPE JA A-C, SWITCHBOARD PANELS—Continued

SCHEDULE A—Continued

For 480 Volts

Generator Cap. Kva. (Max. Continuous)	Current Trans. Pri. Amps. (5 Amp. Secondary)	Ammeter Scale	Ampere Capacity of Switch	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
				Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
25	50	40	30	357398	\$415 00	\$425 00	357411	\$355 00	\$365 00
37.5	50	60	60	357399	420 00	430 00	357412	360 00	370 00
50	75	80	60	357400	425 00	435 00	357413	365 00	375 00
62.5	100	100	100	357401	430 00	440 00	357414	370 00	380 00
75	100	120	100	357402	430 00	440 00	357415	370 00	380 00
100	150	150	200	357403	445 00	455 00	357416	385 00	395 00
125	200	200	200	357404	450 00	460 00	357417	390 00	400 00
150, 156	250	250	200	357405	455 00	465 00	357418	395 00	405 00
175 to 200	300	300	400	357406	465 00	480 00	357419	405 00	420 00
225, 250	400	400	400	357407	470 00	485 00	357420	410 00	425 00
275 to 325	500	500	400	357408	475 00	490 00	357421	415 00	430 00
350 to 400	600	600	600	357409	490 00	510 00	357422	430 00	450 00
425, 500	750	750	600	357410	500 00	520 00	357423	440 00	460 00

Optional—For the addition of a field ammeter or a polyphase wattmeter refer to paragraph, "Alterations from Standard Panels Listed." For the addition of field ammeter add \$40.00 to list price. For the addition of wattmeter add \$100.00 to the list price.

Approximate Weight, boxed, 700 pounds.

Bus-bars and bus connections are not included in the above style numbers.

THREE-PHASE GENERATOR PANELS

240-480 Volts, 60 Cycles

SCHEDULE B

Using Three Ammeters

For control of one generator, panel Fig.1 should be ordered with the first machine installed, and Fig. 2 with the second and each succeeding machine.

Schedule of Apparatus

- One panel, 16 inches wide.
- Three ammeters, type SY.
- \*One voltmeter, type SY.
- One voltmeter switch, type RS, double-pole, with removable \*handle.
- One drilling only for Westinghouse double-handwheel, remote-control rheostat mounting.
- One synchronizing switch, type RS, with removable \*handle.
- One synchronizing lamp.
- \*One lamp ground detector outfit. (A push button is included for 480 volts only.)
- One cardholder.
- One knife switch, type A, three pole, single-throw.
- One field-discharge switch, type A, two-pole, single-throw, remote-control, mounted on rear of panel with operating handle on the front.
- One mounting only for field-discharge resistor.
- Two current transformers, type K, for use with ammeters.

\*With panel, Fig. 1 only.

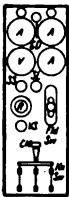


FIG. 1

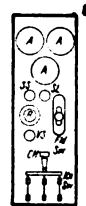


FIG. 2

For 240 Volts

Generator Cap. Kva. (Max. Continuous)	Current Trans. Pri. Amps. (5 Amp. Secondary)	Ammeter Scale	Ampere Capacity of Switch	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
				Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
25	75	75	60	357424	\$470 00	\$480 00	357434	\$420 00	\$430 00
37.5	120	100	100	357425	475 00	485 00	357435	425 00	435 00
50	150	150	200	357426	485 00	495 00	357436	435 00	445 00
62.5	200	200	200	357427	495 00	505 00	357437	445 00	455 00
75	250	200	200	357428	505 00	515 00	357438	455 00	465 00
100	300	300	400	357429	515 00	530 00	357439	470 00	480 00
125	400	400	400	357430	525 00	540 00	357440	475 00	490 00
150, 156	500	500	400	357431	530 00	545 00	357441	480 00	495 00
175 to 200	600	500	600	357432	535 00	555 00	357442	485 00	505 00
225 to 250	750	750	600	357433	545 00	565 00	357443	495 00	515 00

(Continued on next page)

Order by Style Number

TYPE JA A-C. SWITCHBOARD PANELS—Continued

SCHEDULE B—Continued  
For 480 Volts

Generator Cap. Kva. (Max. Continuous)	Current Trans. Ammeter Scale	Pri. Amps. (5 Amp. Secondary)	Ampere Capacity of Switch	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
				Panel Style No.	LIST PRICE		Panel Style No.	LIST PRICE	
					Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
25	40	50	30	357444	\$475 00	\$485 00	357457	\$415 00	\$425 00
37.5	60	50	60	357445	480 00	490 00	357458	420 00	430 00
50	80	75	60	357446	485 00	495 00	357459	425 00	435 00
62.5	100	100	100	357447	490 00	500 00	357460	430 00	440 00
75	120	100	100	357448	490 00	500 00	357461	430 00	440 00
100	150	150	200	357449	500 00	510 00	357462	440 00	450 00
125	200	200	200	357450	510 00	520 00	357463	450 00	460 00
150, 156	250	200	200	357451	520 00	530 00	357464	460 00	470 00
175 to 200	300	300	400	357452	530 00	545 00	357465	470 00	485 00
225, 250	400	400	400	357453	540 00	555 00	357466	480 00	495 00
275 to 325	500	500	400	357454	545 00	560 00	357467	485 00	500 00
350 to 400	600	600	600	357455	550 00	570 00	357468	490 00	510 00
425, 500	750	750	600	357456	560 00	580 00	357469	500 00	520 00

Optional—For the addition of a field ammeter or a polyphase wattmeter refer to paragraph. "Alterations from Standard Panels Listed." For the addition of field ammeter add \$40.00 to the list price. For the addition of wattmeter add \$100.00 to the list price.

Approximate weight, boxed, 700 pounds.

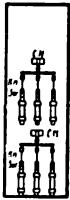
Bus-bars and bus connections are not included in the above style numbers.

THREE-PHASE FEEDER PANELS

240-480 Volts

SCHEDULE C

Without Ammeters



For control of two feeders with switches fused on front of panel.

Schedule of Apparatus

One panel, 16 inches wide.

Two cardholders.

Two knife switches, type A, three-pole, single-throw, with enclosed fuses mounted on front of panel.

For 240 Volts

Amperes Switch and Fuses	Panel Style No.	LIST PRICE	
		Individual Operation	Bus-Bar Operation
20	306698	\$135 00	\$150 00
60	306699	150 00	185 00
100	306700	170 00	185 00

For 480 Volts

Amperes Switch and Fuses	Panel Style No.	LIST PRICE	
		Individual Operation	Bus-Bar Operation
30	306701	\$145 00	\$160 00
60	306702	160 00	175 00
100	306703	180 00	195 00

Approximate weight, boxed 400 pounds.

Bus-bars and bus connections are not included in the above style numbers.

THREE-PHASE FEEDER PANELS

240-480 Volts

SCHEDULE D

Without Ammeter

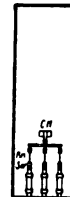
For the control of one feeder with switch fused on front of panel.

Schedule of Apparatus

One panel, 16 inches wide.

One cardholder.

One knife switch, type A, three-pole, single-throw, with enclosed fuses mounted on front of panel.



For 240 Volts

Amperes Switch and Fuses	Panel Style No.	LIST PRICE	
		Individual Operation	Bus-Bar Operation
30	306706	\$125 00	\$135 00
60	306707	135 00	145 00
100	306708	145 00	155 00
200	306709	155 00	170 00
400	306710	190 00	205 00
600	306711	235 00	255 00

For 480 Volts

Amperes Switch and Fuses	Panel Style No.	LIST PRICE	
		Individual Operation	Bus-Bar Operation
30	306712	\$130 00	\$140 00
60	306713	140 00	150 00
100	306714	150 00	160 00
200	306715	180 00	175 00
400	306716	200 00	215 00
600	306717	245 00	265 00

Approximate weight, boxed 400 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

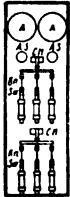
TYPE JA A-C. SWITCHBOARD PANELS—Continued

THREE-PHASE FEEDER PANELS

240-480 Volts, 60 Cycles

SCHEDULE E

For the control of two three-phase feeders, with ammeters and ammeter switches for reading current in each phase, and with switches fused on front of panels.



Schedule of Apparatus

- One panel, 16 inches wide.
- Two ammeters, type SY.
- Two ammeter switches, type RS, for reading current in each phase.
- Two cardholders.
- Two knife switches, type A, three-pole, single-throw, with enclosed fuses mounted on front of panel.
- Four current transformers, type K, for ammeters.

Current Trans.			WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
Amperes Fuses	Pri. Amps. secondary) and Ammeter Scale	Amperes Switch	Panel Style No. For 240 Volts	LIST PRICE		Panel Style No. For 480 Volts	LIST PRICE	
				Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
5	10	30	357470	\$320 00	\$335 00	357477	\$330 00	\$345 00
10	15	30	357471	330 00	345 00	357478	340 00	355 00
15	25	30	357472	340 00	355 00	357479	350 00	365 00
30	50	30	357473	355 00	370 00	357480	365 00	380 00
60	75	60	357474	370 00	385 00	357481	380 00	395 00
75	100	100	357475	390 00	405 00	357482	400 00	415 00
100	150	100	357476	400 00	415 00	357483	410 00	425 00

**Optional**—When the load on each circuit is balanced, the ammeters may be connected to read current only in one phase and the ammeter switches and two current transformers may be omitted at a reduction in price, depending on the capacity. Refer to the Works for quotation.

Approximate weight, boxed 500 pounds.

Bus-bars and bus connections are not included in the above style numbers.

THREE-PHASE FEEDER PANELS

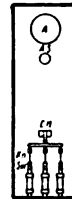
240-480 Volts, 60 Cycles

SCHEDULE F

For the control of one three-phase feeder, with ammeter and ammeter switch for reading current in each phase, and with switch fused on front of panels.

Schedule of Apparatus

- One panel, 16 inches wide.
- One ammeter, type SY.
- One ammeter switch, type RS, for reading current in each phase.
- One cardholder.
- One knife switch, type A, three-pole, single-throw, with enclosed fuses mounted on front of panel.
- Two current transformers, type K, for ammeter.



Current Trans.			WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
Amperes Fuses	Pri. Amps. secondary) and Ammeter Scale	Amperes Switch	Panel Style No. For 240 Volts	LIST PRICE		Panel Style No. For 480 Volts	LIST PRICE	
				Individual Operation	Bus-Bar Operation		Individual Operation	Bus-Bar Operation
5	10	30	357484	\$225 00	\$235 00	357496	\$230 00	\$240 00
10	15	30	357485	230 00	240 00	357497	235 00	245 00
15	25	30	357486	235 00	245 00	357498	240 00	250 00
30	50	30	357487	245 00	255 00	357499	250 00	260 00
60	75	60	357488	255 00	265 00	357500	260 00	270 00
75	100	100	357489	270 00	280 00	357501	275 00	285 00
100	150	100	357490	275 00	285 00	357502	280 00	290 00
150	200	200	357491	290 00	300 00	357503	295 00	305 00
200	300	200	357492	295 00	305 00	357504	300 00	310 00
300	400	400	357493	320 00	335 00	357505	325 00	340 00
400	500	400	357494	325 00	340 00	357506	330 00	345 00
600	750	600	357495	375 00	390 00	357507	385 00	400 00

**Optional**—When the load is balanced, the ammeter may be connected to read current only in one phase and the ammeter switch and one current transformer may be omitted at a reduction in price, depending on the capacity. Refer to the Works for quotation.

Approximate weight, boxed 450 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

TYPE JA A-C. SWITCHBOARD PANELS—Continued

THREE-PHASE FEEDER PANELS

240-480 Volts, 60 Cycles

SCHEDULE G

For the control of two three-phase feeders with ammeters and ammeter switches for reading the current in each phase, or without ammeters. Fuse protection on rear.

Schedule of Apparatus

- One panel, 16 inches wide.
- Two ammeters, type SY, with Fig. 1 only.
- Two ammeter switches, Type RS, for reading current in each phase with Fig. 1 only.
- Two cardholders.
- Two knife switches, type A, three pole, single throw.
- Enclosed fuses mounted on rear of panel.
- Four current transformers, type K, for ammeters.

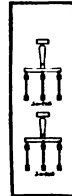
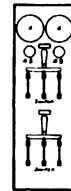


FIG. 1

FIG. 2

			WITH AMMETER FIG. 1			WITHOUT AMMETER FIG. 2		
			LIST PRICE			LIST PRICE		
Amperes and Fuses	Pri. Amps. (5 Amp. Secondary) Ammeter Scale	Amperes Switch	Panel Style No.	Individual Operation	Bus-Bar Operation	Panel Style No.	Individual Operation	Bus-Bar Operation
<b>For 240 Volts</b>								
5	10	30	357508	\$345 00	\$360 00	357520	\$155 00	\$160 00
10	15	30	357509	355 00	370 00	.....	.....	.....
15	25	30	357510	365 00	380 00	.....	.....	.....
30	50	30	357511	380 00	395 00	.....	.....	.....
60	75	60	357512	395 00	410 00	357521	175 00	190 00
75	100	100	357513	420 00	435 00	357522	200 00	220 00
100	150	100	357514	440 00	455 00	.....	.....	.....
150	200	200	357515	475 00	495 00	357523	220 00	240 00
200	300	200	357516	485 00	505 00	.....	.....	.....
300	400	400	357517	545 00	570 00	357524	300 00	325 00
400	500	400	357518	555 00	580 00	.....	.....	.....
600	750	600	357519	680 00	710 00	357525	435 00	465 00
<b>For 480 Volts</b>								
5	10	30	357526	355 00	370 00	357538	165 00	180 00
10	15	30	357527	365 00	380 00	.....	.....	.....
15	25	30	357528	375 00	390 00	.....	.....	.....
30	50	30	357529	390 00	405 00	.....	.....	.....
60	75	60	357530	405 00	420 00	357539	185 00	200 00
75	100	100	357531	430 00	450 00	357540	210 00	230 00
100	150	100	357532	450 00	470 00	.....	.....	.....
150	200	200	357533	485 00	505 00	357541	235 00	255 00
200	300	200	357534	495 50	515 00	.....	.....	.....
300	400	400	357535	555 00	580 00	357542	310 00	335 00
400	500	400	357436	565 00	590 00	.....	.....	.....
600	750	600	357437	690 00	720 00	357543	445 00	475 00

**Optional**—When the load on each circuit is balanced, the ammeters on panels having them may be connected to read current only in one phase and the ammeter switches and two current transformers may be omitted at a reduction in price, depending on the capacity. Refer to Works for quotation.

**Approximate weight**, boxed, 500 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

## TYPE JB A-C. SWITCHBOARD PANELS

1200—2400—3300 VOLTS, 120 AMPERES MAXIMUM

**Application**—Type JB switchboards are particularly adapted to the control of single or parallel-operated alternators and feeder circuits in small isolated stations and industrial plants.

**Rating**—These switchboard panels are suitable for use on 1200-, 2400- and 3300-volt, single-phase, two-phase and three-phase systems of all frequencies. They are listed for control of 2400-volt 60-cycle generators and single- and three-phase feeder circuits. Panels having ratings not scheduled are special and should be referred to the Company, except for 3300-volt 3-phase generators. Order panels of a suitable ampere capacity from the 2400-volt schedules, except for 3300 volts, increasing by \$10.00 the list price of the same ampere capacity 2400-volt panel to provide for the required change in voltage transformer, etc. The capacity of a single generator or feeder panel, as listed, is limited to 120 amperes, and that of a complete switchboard to 400 amperes. However, special panels may be ordered of a capacity up to 200 amperes for generators and for feeders, when desired, by taking the matter up with the Company. For greater capacities, a switchboard from the type E lines is recommended.

**Panel Construction**—Each panel consists of a single section, 48 inches high by  $1\frac{1}{2}$  inches thick, with  $\frac{1}{4}$ -inch bevels on front edges, bolted at the four corners to a type J  $1\frac{1}{4}$ -inch pipe frame. The total height of the panels is 76 inches. As indicated by the type letter B, the equipment consists of panel-mounting, manually-operated oil circuit-breakers.

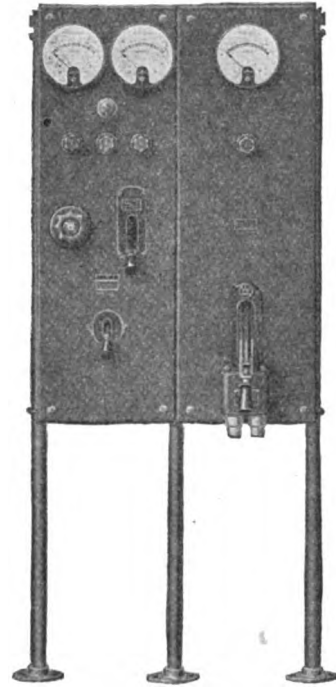
**Automatic Protection**—Standard panels provide no automatic protection for the main or field circuits of alternating-current generators, except that schedules are provided listing automatic generator breakers for separately operated generators when the generator breaker is also used to provide automatic protection for a single feeder circuit. Under these conditions of operation, automatic protection may also be obtained by providing a subsection with fuses. This is mounted on the pipe framework immediately below the generator panel.

Feeder panels are listed with the following kinds of overload protection:

- (a) Automatic oil circuit-breakers.
- (b) Non-automatic oil circuit-breakers with rear-connected fuses. These fuses are removable from the front of panel, but have no live parts exposed.

Feeder panels having a non-automatic oil circuit-breaker, but without fuses, are also listed. When these panels are selected, necessary fuses should be ordered extra for mounting apart from the switchboard.

The advantages of the automatic circuit-breaker are; it is quickly and easily closed after opening the circuit, it cannot be held in a closed position while



TYPE JB A-C. SWITCHBOARD PANELS

an overload condition exists on the line, and it eliminates the trouble and expense of replacing the fuses.

One set of fuses is supplied with each panel equipped with fuse blocks.

**Apparatus**—The voltmeters provided are type SY; the ammeters, type SY; the non-automatic oil circuit-breakers, types I and D; the automatic oil circuit-breakers, type F-11; the fuses are of the enclosed rear-connected type; and the generator field switches, type A, mounted on the rear of the generator panels with the operating handles on the front.

**Safety**—This line of switchboard panels has no live parts on the front of the panels.

**Field Rheostats**—The generator panels are designed to have the exciter and generator rheostats separately mounted and operated by a remote-control mechanism. The handwheels for operating the rheostats are concentric and operated from the front of the panels. The rheostats and rheostat-operating mechanisms are not included with the panels, as they are generally furnished with the machines. If desired, a standard rheostat-operating mechanism will be furnished with the switchboard at an increase in cost; specify double-handwheel remote-control rheostat mounting Style No. 290894 from catalogue section 2-B.

**Ground Detector Equipments**—Ground detectors are not supplied as part of the standard panel

TYPE JB A-C. SWITCHBOARD PANELS—Continued

equipments and must be ordered separately when required. For 2400-volt, 3-phase systems specify:

One Ground Detector Equipment, Style No. 306472, list price \$95.00.

The style number includes one 3-phase electrostatic glower ground detector, with condenser-type terminals, bracket for mounting the detector above switchboard, and the necessary connecting leads.

The question of detectors for all 1200- and 3300-volt systems and 2400-volt single- and 2-phase systems should be referred to the Company.

**Synchronizing**—A rotary type synchronizing switch and an incandescent lamp for synchronizing between machines are furnished with each generator panel. The same transformer used in connection with the voltmeter is used for synchronizing. If synchronizing between bus and machine is desired, add one voltage transformer with fuses for connecting to bus. A type SI synchroscope mounted on a swinging bracket at the side of the switchboard will be supplied at extra cost.

**Exciter Control**—Each generator panel is designed to have the generator field connected to a single

exciter through a two-pole field switch with field discharge contact. If parallel operation of exciters is desired, exciter panels should be ordered.

**Bus-bars**—Bus-bars, when necessary, should be ordered separately as follows:

Max. Bus-Bar Capacity Amperes	Conductors	LIST PRICE, PER FOOT LENGTH OF SWITCHBOARD	
		Single-Phase	Three-Phase
150	.365 R. I. F. P. wire	\$1 50	\$2 50
225	.460 R. I. F. P. wire	3 00	5 00
300	1/4" dia. Copper rod } insulated	4 00	6 50
400	1/4" dia. Copper rod }	5 00	8 00

**Sub-Sections for Watthour Meters**—The following style numbers include a sub-section with mounting brackets, meter-transformer brackets, and wiring, for mounting immediately below the main sections. The meter and transformers are not included. The section is drilled for a polyphase glass-cover type OA switchboard-mounting watthour meter.

Size of Section Inches	Panel Style No.	List Price
12"x28"x1 1/4"	308473	\$25 00
16"x28"x1 1/4"	308474	31 00
20"x28"x1 1/4"	308475	34 00
24"x28"x1 1/4"	308476	38 00
32"x28"x1 1/4"	308477	45 00

Interrupting Capacity of Oil Switches and Oil Circuit-Breakers

Apparatus	INTERRUPTING CAPACITY Amperes per Phase at 2500 Volts
Type I, 60-Ampere, 4500-Volt Oil Circuit-Breaker.....	610
Type D, 200-Ampere, 4500-Volt Oil Circuit-Breaker.....	1630
Type F-11, Oil Circuit-Breaker, Transformer-Trip.....	6500

**Panel Style Numbers**—The panel style numbers include the frame, wall brace ends, the panel with apparatus mounted thereon according to the sched-

ule given, and necessary details and connections on rear for operating a single panel. See also Instructions for Ordering.

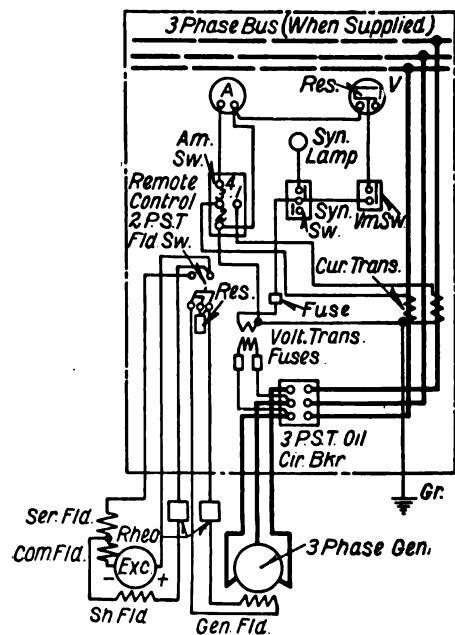
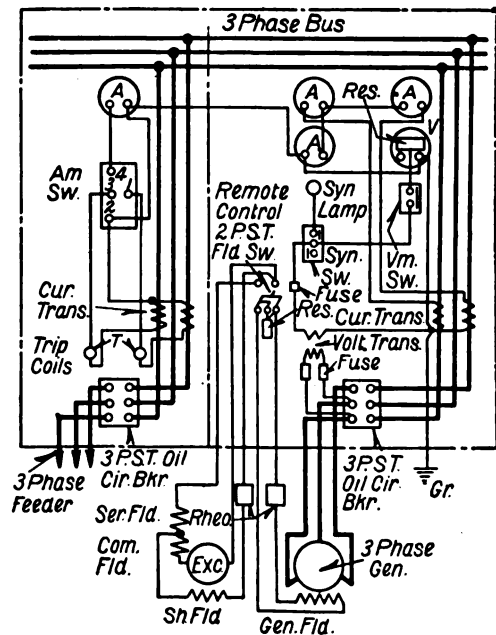


DIAGRAM OF TYPICAL CONNECTIONS



TYPE JB A-C. SWITCHBOARD PANELS—Continued

**TYPE JB THREE-PHASE GENERATOR PANELS**  
**2400 Volts 60 Cycles**  
**SCHEDULE A**

For the control of one generator, operating separately or in parallel. Using one ammeter with ammeter switch and a non-automatic oil circuit-breaker.



FIG. 1



FIG. 2

Panel Fig. 1 should be ordered with the first machine installed, and Fig. 2 with the second and each succeeding machine.

**Schedule of Apparatus**

- One panel, 16 inches wide.
- One ammeter, type SY.
- \*One voltmeter, type SY.
- One voltmeter switch, type RS, single-pole with removable \*handle.
- One ammeter switch, type RS, 3-phase for reading current in each line.
- One drilling only for Westinghouse double-hand-wheel remote-control rheostat mounting.
- One synchronizing switch, type RS, with removable \*handle.
- One synchronizing lamp.

- One field-discharge switch, type A, two-pole single-throw, remote-control mounted on rear of panel with operating handle on the front.
- One cardholder.
- One oil circuit-breaker, type I up to 275 Kva., type D for 275 Kva. and above, non-automatic, three-pole, single-throw.
- Two current transformers, type K.
- One voltage transformer with two-pole fuse block and two fuses.
- One mounting only for field discharge resistor.

\*With panel Fig. 1 only.

Generator Cap. Kva. (Max. Continuous.)	Ammeter Scale	Current Trans. Pri. Amps. (5 Amp. secondary)	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
			Panel Style No.	Individual Operation	Bus-Bar Operation	Panel Style No.	Individual Operation	Bus-Bar Operation
37.5	12	15	358785	\$450 00	\$465 00	358798	\$390 00	\$405 00
50	15	15	358786	450 00	465 00	358799	390 00	405 00
62.5	20	25	358787	455 00	470 00	358800	395 00	410 00
75	25	25	358788	455 00	470 00	358801	395 00	410 00
100	40	25	358789	460 00	475 00	358802	400 00	415 00
125	40	50	358790	465 00	480 00	358803	405 00	420 00
150, 156	50	50	358791	470 00	485 00	358804	410 00	425 00
175 to 200	60	50	358792	475 00	490 00	358805	415 00	430 00
225	75	75	358793	480 00	495 00	358806	420 00	435 00
250	80	75	358794	485 00	500 00	358807	425 00	440 00
275 to 325	100	100	358795	500 00	515 00	358808	440 00	455 00
350 to 400	120	100	358796	505 00	520 00	358809	445 00	460 00
425, 500	150	150	358797	510 00	525 00	358810	450 00	465 00

Approximate weight boxed, 700 pounds.

Bus-bars and bus connections are not included in the above style numbers.

**Optional**

(a) Where panels are not required for parallel operation the following apparatus may be omitted from generator panels having voltmeters, at a decrease in list price of \$16.00.

- One synchronizing switch, handle, and lamp.
- One voltmeter switch and handle.

(b) If voltmeter indication is required for all three phases the voltmeter switch (Figs. 1 and 2) can be replaced by a three-phase type RS voltmeter switch, and a voltage transformer with dou-

ble-pole fuse block and two fuses added at an increase in list price of \$55.00

(c) A generator field ammeter or a polyphase wattmeter may be added at an increase in price. When either is added to a panel having a voltmeter, the voltmeter is mounted on a swinging bracket at the side of the panel and the added instrument takes its place on the panel.

Additions	List Price
Type SX field ammeter.....	\$ 60 00
Type SY wattmeter (one additional voltage transformer with fuses and fuse block included).....	175 00

Order by Style Number

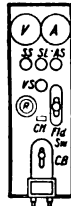
TYPE JB A-C. SWITCHBOARD PANELS—Continued

**TYPE JB THREE-PHASE GENERATOR PANELS**  
**2400 Volts, 60 Cycles**  
**SCHEDULE B**

For the control of one generator, operating separately, using one ammeter with ammeter switch and an automatic oil circuit-breaker.

This line of panels is designed for use when a single feeder circuit is supplied by a single generator. Since the oil circuit-breakers are automatic, the panels listed are suitable for controlling both the generator and feeder. If the load increases so that more than one generator is required, panels with non-automatic oil circuit-breakers and without voltmeters selected from Schedule A should be added; automatic protection being used only on the feeder circuits.

If generator or feeder circuits are added after this class of panel has been installed, the oil circuit-breaker can be made non-automatic by short circuiting the breaker trip coils. The synchronizing equipment and voltmeter switch with handle are furnished for future parallel operation.



**Schedule of Apparatus**

- One panel, 16 inches wide.
- One ammeter, type SY.
- One voltmeter, type SY.
- One voltmeter switch, type RS, single-pole, with removable handle.
- One ammeter switch, type RS, 3-phase, for reading current in each line.
- One drilling only for Westinghouse double-hand-wheel remote-control rheostat mounting.
- One synchronizing switch, type RS, with removable handle.

- One synchronizing lamp.
- One field-discharge switch, type A, two-pole, single-throw, remote-control mounted on rear of panel with operating handle on the front.
- One cardholder.
- One oil circuit-breaker, type F-11, transformer trip overload, automatic, three-pole, single-throw.
- Two current transformers, type K.
- One voltage transformer with two-pole fuse block and two fuses.
- One mounting only for field discharge resistor.

Generator Cap. Kva. (Max. Continuous.)	Ammeter Scale	Current Trans. Pri. Amps. (5 Amp. secondary)	Panel Style No.	List Price
37.5	12	15	358811	\$515 00
50	15	15	358812	515 00
62.5	20	25	358813	520 00
75	25	25	358814	520 00
100	40	25	358815	525 00
125	40	50	358816	525 00
150, 156	50	50	358817	530 00
175 to 200	60	50	358818	530 00
225	75	75	358819	535 00
250	80	75	358820	535 00
275 to 325	100	100	358821	540 00
350 to 400	120	100	358822	540 00
425, 500	150	150	358823	545 00

Approximate weight boxed, 800 pounds.  
 Bus-bars and bus connections are not included in the above style numbers.

**Optional**

- (a) Where panels are not required for future parallel operation the following apparatus may be omitted from generator panels at a decrease in list price of \$16.00
  - One synchronizing switch, handle, and lamp.
  - One voltmeter switch and handle.
- (b) If voltmeter indication is required for all three phases the voltmeter switch can be replaced by a three-phase type RS voltmeter switch, and a voltage transformer with double-pole fuse block and two fuses added at an increase in list price of \$55.00
- (c) A generator field ammeter or a polyphase wattmeter may be added at an increase in price. When either is added to a panel having a voltmeter, the voltmeter is mounted on a swinging bracket at the side of the panel and the added instrument takes its place on the panel.

Additions	Price List
Type SX field ammeter .....	\$ 80 00
Type SY wattmeter (one additional voltage transformer with fuses and fuse block included).....	175 00

Order by Style Number

TYPE JB A-C. SWITCHBOARD PANELS—Continued

**TYPE JB THREE-PHASE GENERATOR PANELS**  
**2400 Volts, 60 Cycles**  
**SCHEDULE C**

For the control of one generator operating separately or in parallel, using three ammeters and a non-automatic oil circuit-breaker.



Fig. 1

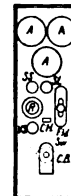


Fig. 2

Panel Fig. 1 should be ordered with the first machine installed, and Fig. 2 with the second and each succeeding machine.

**Schedule of Apparatus**

- One panel, 16 inches wide.
- Three ammeters, type SY.
- \*One voltmeter, type SY.
- One voltmeter switch, type RS, single-pole with removable\*handle.
- One drilling only for Westinghouse double-hand-wheel remote-control rheostat mounting.
- One synchronizing switch, type RS, with removable\*handle.
- One synchronizing lamp.

- One field-discharge switch, type A, two-pole, single-throw, remote-control mounted on rear of panel with operating handle on the front.
- One cardholder.
- One oil circuit-breaker, type I up to 275 Kva., type D for 275 Kva. and above, non-automatic, three-pole, single-throw.
- Two current transformers, type K.
- One voltage transformer with double-pole fuse block and two fuses.
- One mounting only for field-discharge resistor.
- \*With panel Fig. 1 only.

Generator Cap. Kva. (Max. Continuous.)	Ammeter Scale	Current Trans. Pri. Amps. (5 Amp. Secondary.)	WITH VOLTMETER, FIG. 1			WITHOUT VOLTMETER, FIG. 2		
			Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
37.5	12	15	358824	\$485 00	\$500 00	358837	\$425 00	\$440 00
5	15	15	358825	485 00	500 00	358838	425 00	440 00
62.5	20	25	358826	490 00	505 00	358839	430 00	445 00
75	25	25	358827	495 00	510 00	358840	435 00	450 00
100	40	25	358828	500 00	515 00	358841	440 00	455 00
125	40	50	358829	505 00	520 00	358842	445 00	460 00
150, 156	50	50	358830	510 00	525 00	358843	450 00	465 00
175 to 200	60	50	358831	515 00	530 00	358844	455 00	470 00
225	75	75	358832	520 00	535 00	358845	460 00	475 00
250	80	75	358833	525 00	540 00	358846	465 00	480 00
275 to 325	100	100	358834	530 00	545 00	358847	470 00	485 00
350 to 400	120	100	358835	535 00	550 00	358848	475 00	490 00
425, 500	150	150	358836	540 00	555 00	358849	480 00	495 00

Approximate weight boxed, 700 pounds.

Bus-bars and bus connections are not included in the above style numbers.

**Optional**

(a) Where panels are not required for parallel operation the following apparatus may be omitted from generator panels having voltmeters, at a decrease in list price of \$16.00

- One synchronizing switch, handle, and lamp.
- One voltmeter switch and handle.

(b) If voltmeter indication is required for all three phases the voltmeter switch (Figs. 1 and 2) can be replaced by a three-phase type RS voltmeter switch, and a voltage transformer with double-pole

fuse block and two fuses added at an increase in list price of \$55.00.

(c) A generator field ammeter or a polyphase wattmeter may be added at an increase in price. When either is added to a panel having a voltmeter, the voltmeter is mounted on a swinging bracket at the side of the panel and the added instrument takes its place on the panel.

**Additions**

Type SX field ammeter.....	List Price \$ 60 00
1 type SY wattmeter (one additional voltage transformer with fuses and fuse block included).....	175 00

Order by Style Number

TYPE JB A-C. SWITCHBOARD PANELS—Continued

FEEDER PANELS WITH AUTOMATIC OIL CIRCUIT-BREAKERS  
—FOR ONE FEEDER

Single and Three-Phase, 2400 Volts, 60 Cycles, Single-Throw

SCHEDULE D

For the control of single and three-phase feeders, using automatic oil circuit-breakers, with ammeter and ammeter switch for reading current in each phase, and without ammeter and ammeter switch.



FIG. 1

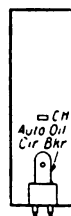


FIG. 2

Schedule of Apparatus

- One panel. 16 inches wide.
- One ammeter, type SY, Fig. 1 only.
- One ammeter switch, type RS, for reading current in each line, with three-phase panels, Fig. 1 only.
- One oil circuit-breaker,\* type F-11, automatic overload, transformer trip, single-throw; two-pole for single-phase, three-pole for three-phase.
- One cardholder.
- One current transformer, type K, for single-phase; two, for three-phase.

Phase	Maximum Continuous Amps. of Feeder	Cur. Trans. Pri Amps. (5 Amp. secondary) and Ammeter Scale	WITH AMMETER, FIG. 1			WITHOUT AMMETER, FIG. 2		
			Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
1	5	10	358850	\$245 00	\$255 00	306537	\$210 00	\$220 00
1	10	15	358851	245 00	255 00	306538	210 00	220 00
1	15	25	358852	250 00	260 00	306539	215 00	225 00
1	40	50	358853	255 00	265 00	306540	220 00	230 00
1	60	75	358854	260 00	270 00	306541	225 00	235 00
1	75	100	358855	265 00	275 00	306542	230 00	240 00
1	100	150	358856	270 00	280 00	306543	235 00	245 00
3	5	10	358857	295 00	310 00	306544	255 00	270 00
3	10	15	358858	300 00	315 00	306545	260 00	275 00
3	15	25	358859	305 00	320 00	306546	265 00	280 00
3	40	50	358860	310 00	325 00	306547	270 00	285 00
3	60	75	358861	315 00	330 00	306548	275 00	290 00
3	75	100	358862	320 00	335 00	306549	280 00	295 00
3	100	150	358863	325 00	340 00	306550	285 00	300 00

\*Overload tripping range of the circuit-breaker is adjustable from 80 per cent to 160 per cent of the rating of the current transformers. The breakers may be equipped with the usual auxiliaries, such as inverse-time-limit attachments as listed in the catalog section in Oil Circuit-Breaker Accessories.

Approximate weight, boxed, 600 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

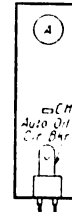
TYPE JB A-C. SWITCHBOARD PANELS—Continued

**TYPE JB FEEDER PANELS**  
**With Automatic Oil Circuit-Breakers—For One Feeder**  
**Three-Phase—2400 Volts—60 Cycles—Single-Throw**  
**SCHEDULE E**

For the control of three-phase feeders; with ammeter in one phase of each feeder.

**Schedule of Apparatus**

- One panel, 16 inches wide.
- One ammeter, type SY.
- One cardholder.
- One oil circuit-breaker,\* type F-11, automatic overload, transformer-trip, three-pole, single-throw.
- Two current transformers, type K.



Phase	Maximum Continuous Amps. of Feeder	Cur. Trans. Pri. Amps. (5 Amp. secondary) and Ammeter Scale	Panel Style No.	LIST PRICE	
				Individual Operation	Bus-Bar Operation
3	5	10	358864	\$290 00	\$305 00
3	10	15	358865	295 00	310 00
3	15	25	358866	300 00	315 00
3	40	50	358867	305 00	320 00
3	60	75	358868	310 00	325 00
3	75	100	358869	315 00	330 00
3	100	150	358870	320 00	335 00

\*Overload tripping range of the circuit-breaker is adjustable from 80 per cent to 160 per cent of the rating of the current transformers. The breakers may be equipped with the usual auxiliaries, such as inverse-time-limit attachments as listed in the catalog section in Oil Circuit-Breaker Accessories.

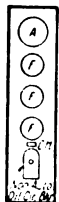
Approximate weight, boxed, 800 pounds.

Bus-bars and bus connections are not included in the above style numbers.

**TYPE JB FEEDER PANELS**  
**With Fuses on Front of Panel—For One Feeder**  
**Single and Three-Phase—2400 Volts—60 Cycles—Single-Throw**  
**SCHEDULE F**

For the control of single and three-phase feeders; with ammeters in one phase of each feeder; or without ammeters, and with fuses in each phase of each feeder.

**Schedule of Apparatus**



THREE-PHASE FEEDER WITH AMMETER

- One panel, 12 inches wide.
- One ammeter, type SY, when included in style number of panel.
- One set of fuse holders and fuses.
- One cardholder.

- One oil circuit-breaker, type I for 5 to 60 amperes, type D for 75 and 100 amperes, non-automatic, single-throw; two-pole for single-phase, three-pole for three-phase.
- One current transformer, type K, for ammeter.

Phase	Maximum Continuous Amps. of Feeder	Cur. Trans. Pri. Amps. (5 Amp. Secondary) and Ammeter Scale	WITH AMMETER			WITHOUT AMMETER		
			Panel Style No.	Individual Operation	Bus-Bar Operation	Panel Style No.	Individual Operation	Bus-Bar Operation
1	5	10	358871	\$190 00	\$200 00	188658	\$155 00	\$185 00
1	10	15	358872	195 00	205 00	188659	160 00	170 00
1	15	25	358873	200 00	210 00	188660	165 00	175 00
1	40	50	358874	205 00	215 00	188661	170 00	180 00
1	60	75	358875	210 00	220 00	188662	175 00	185 00
1	75	100	358876	270 00	280 00	188663	235 00	245 00
1	100	150	358877	275 00	285 00	188664	240 00	250 00
3	5	10	358878	220 00	235 00	187806	185 00	200 00
3	10	15	358879	225 00	240 00	187807	190 00	205 00
3	15	25	358880	230 00	245 00	187808	195 00	210 00
3	40	50	358881	235 00	250 00	187809	200 00	215 00
3	60	75	358882	240 00	255 00	187810	205 00	220 00
3	75	100	358883	340 00	355 00	187811	305 00	320 00
3	100	150	358884	345 00	360 00	187812	310 00	325 00

Approximate weight, boxed, 700 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

TYPE JB A-C. SWITCHBOARD PANELS—Continued

TYPE JB FEEDER PANELS

With Fuses on Front of Panel—For Two Feeders  
Single and Three-Phase—2400 Volts—60 Cycles—Single-Throw

SCHEDULE G

For the control of single and three-phase feeders; with ammeter in one phase of each feeder, or without ammeter. and with fuses in each phase of each feeder.

Schedule of Apparatus

One panel.  
Per Feeder:

- One ammeter, type SY, when included in style number of panel.
- One set of fuse holders and fuses.
- One cardholder.
- One oil circuit-breaker, type I for 5 to 60 amperes, type D for 75 and 100 amperes, non-automatic, single-throw; two-pole for single-phase, three-pole for three-phase.
- One current transformer, type K, for ammeter.



TWO THREE-PHASE FEEDERS WITH AMMETERS

Phase	Max-imum Con-tinuous Amps. of Feeder	Cur. Trans. Pri. Amps. (5 Amp. Second-ary) and Ammeter Scale	Panel Width Inches	WITH AMMETER			WITHOUT AMMETER		
				Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation
1	5	10	20	358885	\$320 00	\$330 00	187813	\$250 00	\$260 00
1	10	15	20	358886	325 00	335 00	187814	255 00	265 00
1	15	25	20	358887	330 00	340 00	187815	260 00	270 00
1	40	50	20	358888	335 00	345 00	187816	265 00	275 00
1	60	75	20	358889	340 00	350 00	187817	270 00	280 00
1	75	100	24	358890	515 00	525 00	187818	445 00	455 00
1	100	150	24	358891	520 00	530 00	187819	450 00	460 00
3	5	10	20	358892	385 00	405 00	187827	315 00	335 00
3	10	15	20	358893	390 00	410 00	187828	320 00	340 00
3	15	25	20	358894	395 00	415 00	187829	325 00	345 00
3	40	50	20	358895	400 00	420 00	187830	330 00	350 00
3	60	75	20	358896	405 00	425 00	187831	335 00	355 00
3	75	100	24	358897	650 00	670 00	187832	580 00	600 00
3	100	150	24	358898	655 00	675 00	187833	585 00	605 00

Approximate weight, boxed, 700 pounds.

Bus-bars and bus connections are not included in the above style numbers.

TYPE JB FEEDER PANELS

Without Fuses—For One Feeder  
Single and Three-Phase—2400 Volts—60 Cycles—Single-Throw

SCHEDULE H

For the control of single or three-phase feeders; with ammeter in one phase of each feeder, or without ammeter.

Fuse blocks are not furnished with these panels and should be ordered extra for separate mounting.

Schedule of Apparatus

- One panel, 12 inches wide.
- One ammeter, type SY, Fig. 1 only.
- One cardholder.
- One oil circuit-breaker, type I for 5 to 60 amperes, type D for 75 and 100 amperes, non-automatic, single-throw; two-pole for single phase, three-pole for three-phase.
- One current transformer, type K, for ammeter.

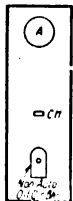


FIG. 1



FIG. 2

(Continued on next page)

Order by Style Number

TYPE JB A-C. SWITCHBOARD PANELS—Continued  
SCHEDULE H—Continued

Phase Feeder	Max-imum Con-tinuous Amps. of	Cur. Trans. Pri. Amps. (5 Amp. Second-ary) and Ammeter Scale	WITH AMMETER, FIG. 1			WITHOUT AMMETER, FIG. 2		
			Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
1	5	10	358899	\$145 00	\$155 00	187918	\$110 00	\$120 00
1	10	15	358900	145 00	155 00	187918	110 00	120 00
1	15	25	358901	145 00	155 00	187918	110 00	120 00
1	40	50	358902	150 00	160 00	187918	110 00	120 00
1	60	75	358903	150 00	160 00	187918	110 00	120 00
1	75	100	358904	175 00	190 00	187919	145 00	155 00
1	100	150	358905	180 00	195 00	187919	145 00	155 00
3	5	10	358908	160 00	175 00	187922	125 00	140 00
3	10	15	358907	160 00	175 00	187922	125 00	140 00
3	15	25	358908	160 00	175 00	187922	125 00	140 00
3	40	50	358909	165 00	180 00	187922	125 00	140 00
3	60	75	358910	165 00	180 00	187922	125 00	140 00
3	75	100	358911	185 00	210 00	187923	165 00	180 00
3	100	150	358912	200 00	215 00	187923	165 00	180 00

Approximate weight, boxed, 800 pounds.

Bus-bars and bus connections are not included in the above style numbers.

TYPE JB FEEDER PANELS  
Without Fuses—For Two or Four Feeders  
Single and Three-Phase—2400 Volts—60 Cycles—Single-Throw

SCHEDULE I

For the control of single or three-phase feeders; with ammeter in one phase of each feeder, or without ammeter.

Fuse blocks are not furnished with these panels and should be ordered extra for separate mounting.

Schedule of Apparatus

- One panel.
- Per Feeder:
  - One ammeter, type SY, Fig. 1 only.
  - One cardholder.
  - One oil circuit-breaker, type I for 5 to 60 amperes, type D for 75 and 100 amperes, non-automatic, single-throw; two-pole for single-phase, three-pole for three-phase.
  - One current transformer, type K, for ammeter.

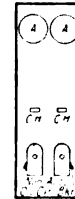


FIG. 1

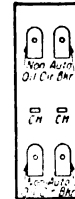


FIG. 2

Phase Feeder	No of Feeders	Max-imum Con-tinuous Amps. of	Cur. Trans. Pri. Amps. (5 Amp. Second-ary) and Ammeter Scale	Panel Width In-ches	Fig. No.	WITH AMMETER, FIG. 1			WITHOUT AMMETER, FIG. 2		
						Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE	Panel Style No.	Individual Operation LIST PRICE	Bus-Bar Operation LIST PRICE
1	2	5	10	16	1	358913	\$230 00	\$240 00	187924	\$160 00	\$170 00
1	2	10	15	16	1	358914	230 00	240 00	187924	160 00	170 00
1	2	15	25	16	1	358915	230 00	240 00	187924	160 00	170 00
1	2	40	50	16	1	358916	235 00	245 00	187924	160 00	170 00
1	2	60	75	16	1	358917	235 00	245 00	187924	160 00	170 00
1	2	75	100	16	1	358918	285 00	295 00	187925	220 00	230 00
1	2	100	150	16	1	358919	290 00	300 00	187925	220 00	230 00
3	2	5	10	16	1	358920	250 00	270 00	187928	180 00	200 00
3	2	10	15	16	1	358921	250 00	270 00	187928	180 00	200 00
3	2	15	25	16	1	358922	250 00	270 00	187928	180 00	200 00
3	2	40	50	16	1	358923	255 00	275 00	187928	180 00	200 00
3	2	60	75	16	1	358924	255 00	275 00	187928	180 00	200 00
3	2	75	100	16	1	358925	325 00	345 00	187929	260 00	280 00
3	2	100	150	16	1	358926	330 00	350 00	187929	260 00	280 00
1	4	60 (Max)	...	20	2	.....	.....	.....	187930	205 00	215 00
1	4	100	...	24	2	.....	.....	.....	187931	320 00	330 00
3	4	60 (Max)	...	20	2	.....	.....	.....	187934	245 00	265 00
3	4	100	...	24	2	.....	.....	.....	187935	395 00	315 00

Approximate weight, boxed, 800 pounds.

Bus-bars and bus connections are not included in the above style numbers.

Order by Style Number

TYPE JB A-C. SWITCHBOARD PANELS—Continued

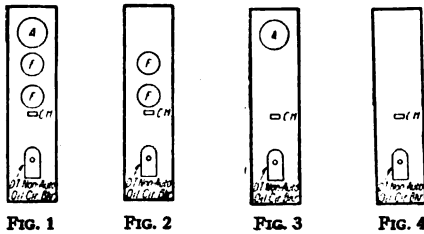
TYPE JB FEEDER PANELS

Double-Throw, Single-Phase, 2400 Volts, 60 Cycles

SCHEDULE J

For the control of one single-phase double-throw feeder with or without ammeter, and with or without fuses and for balancing single-phase feeder on various phases.

Fuse blocks are not supplied with panels Figs. 3 and 4, and should be ordered separately.



Schedule of Apparatus

- One panel, 16 inches wide.
- One ammeter, type SY, with Figs. 1 and 3 only.
- Two fuse holders and fuses, with Figs. 1 and 2 only.
- One cardholder.
- One oil circuit-breaker, type D, non-automatic, 2-pole double-throw.
- One current transformer, type K, for ammeter.

Maximum Continuous Amps. of Feeder	Cur. Trans. Pri. Amps. (5 Amp. Secondary) and Ammeter Scale	WITH AMMETER, FIG. 1 AND 3			WITHOUT AMMETER, FIG. 2 AND 4		
		Panel Style No.	Individual Operation	Bus-Bar Operation	Panel Style No.	Individual Operation	Bus-Bar Operation
<b>With Fuses</b>							
		FIG. 1			FIG. 2		
5	10	358927	\$230 00	\$245 00	188066	\$195 00	\$210 00
10	15	358928	235 00	250 00	188067	200 00	215 00
15	25	358929	240 00	255 00	188068	205 00	220 00
40	50	358930	245 00	260 00	188069	210 00	225 00
60	75	358931	250 00	265 00	188070	215 00	230 00
75	100	358932	300 00	315 00	188071	265 00	280 00
100	150	358933	305 00	320 00	188072	270 00	285 00
<b>Without Fuses</b>							
		FIG. 3			FIG. 4		
5	10	358934	190 00	205 00	188073	155 00	170 00
10	15	358935	195 00	210 00	188073	160 00	175 00
15	25	358936	200 00	215 00	188073	165 00	180 00
40	50	358937	205 00	220 00	188073	170 00	185 00
60	75	358938	210 00	225 00	188073	175 00	190 00
75	100	358939	250 00	265 00	188073	215 00	230 00
100	150	358940	255 00	270 00	188073	220 00	235 00

Approximate weight, boxed, 600 pounds.

TYPE JB PANEL SUB-SECTIONS FOR FUSES

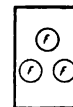
Three-Phase, 2400 Volts

SCHEDULE K

These sections are designed to be mounted on the type J frame immediately below the main generator sections.

They provide automatic protection on the feeder side of the non-automatic oil circuit-breaker when control of only a single generator and a single feeder is required, thus eliminating the feeder panel.

Style number includes sub-section, frame-mounting brackets, three fuse blocks, and one set of fuses



Schedule of Apparatus

One sub-panel, 16 inches wide, 28 inches high, 1½ inches thick.

Three fuse holders and fuses, rear-connected.

Ampere Capacity	Panel Style No.	List Price
10	188088	\$115 00
20	188089	120 00
30	188090	125 00
40	188091	130 00
60	188092	135 00
75	188093	185 00
100	188094	190 00

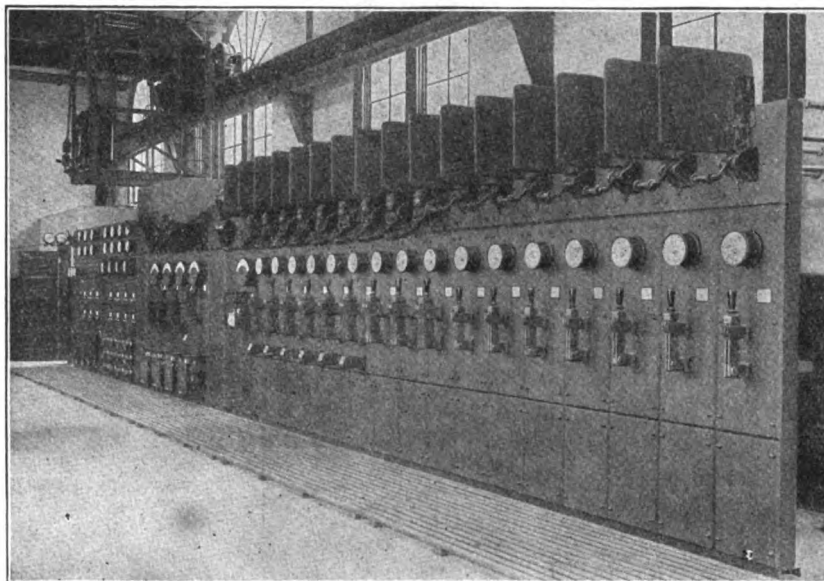
Approximate weight, boxed, 100 pounds.

Order by Style Number

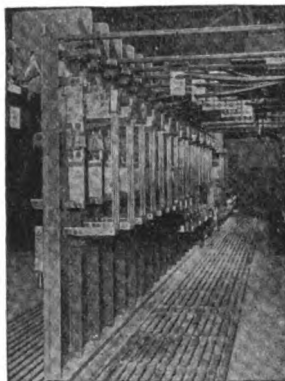


## TYPE GD D-C. SWITCHBOARD PANELS

For 250 Volt, 2-Wire and 3-Wire, Light and Power Service  
and 600-Volt Railway Service



FRONT VIEW OF TYPICAL TYPE GD  
RAILWAY SWITCHBOARD



REAR VIEW OF SAME BOARD  
Showing laminated stud knife switches and circuit-  
breakers, neat and symmetrical arrange-  
ment of copper connections.

**Application**—Type GD switchboards have manually-operated circuit-breakers and are for the control of direct-current generators, direct-current feeders, and the direct-current side of synchronous converters. These panels should be used for all service of this class above 250 volts (except 600-volt mine service) and for other service beyond the capacity of type JD switchboards.

**Capacity**—Individual machine panels are listed for all standard Westinghouse motor-driven generators, compound-wound synchronous converters, and shunt-wound synchronous booster converters. A complete switchboard composed of these panels is limited in ampere capacity only by the interrupt-

ing ability of the circuit-breakers. The limit is not reached in ordinary stations and for all practical purposes, the capacity of these boards may be considered as unlimited.

**Panel Construction**—Each panel consists essentially of three sections—bottom section 20 inches, middle 45 inches, and top 25 inches high—mounted on an angle-iron frame with channel base. The total height of the panel, including base is 92 inches.

**General Description**—The illustrations show more clearly than a written description, the first class appearance, rugged construction and symmetrical design of this line of panels.

Seven-inch D'Arsonval round type ammeters and voltmeters are furnished with these panels. Customers preferring type GL illuminated dial meters may order them at an additional price, in place of the type SX.

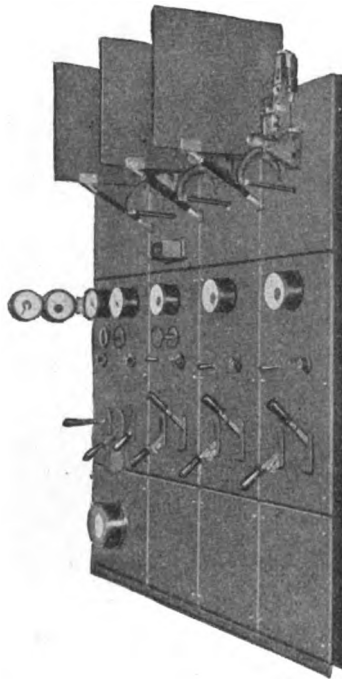
Knife switches and carbon circuit-breakers are of the highest grade of their respective kind, and are furnished with laminated studs for capacities above 1200 amperes. The carbon circuit-breakers furnished with this line of panels are types CA and CL, the inherent features of design of which have been demonstrated by many years of satisfactory service, to be entirely adequate to meet the most exacting operating requirements.

A wiring diagram showing complete connections is furnished with each switchboard.

Further information will be furnished on request.

## DIRECT-CURRENT SWITCHBOARD PANELS

For 1200- to 1500-Volt Service



TYPICAL 1200- OR 1500-VOLT DIRECT-CURRENT SWITCHBOARD  
(WITH END BARRIER OMITTED)

**Application**—These panels are designed to control synchronous converters and motor-generator sets in 1200- to 1500-volt direct-current railway service. They are listed for the control of:

300 and 500 kw., 3-phase, 25-cycle, 1200-volt direct-current synchronous converters.

500 and 1000 kw., 6-phase, 60-cycle, 1200-volt direct-current synchronous converter sets, consisting of two synchronous converters in series.

500 and 750 kw., 1200-volt direct-current generators driven by synchronous motors.

All of these panels are suitable for 1500-volt operation.

**Panel Construction**—Each panel consists of three sections, 2 inches thick with  $\frac{1}{4}$ -inch bevels. The lower section is 25 inches high, the middle section 45 inches high, and the upper section 30 inches high. They are mounted on angle-iron frame with channel-iron base. The total height of the panel, including the base is 102 inches.

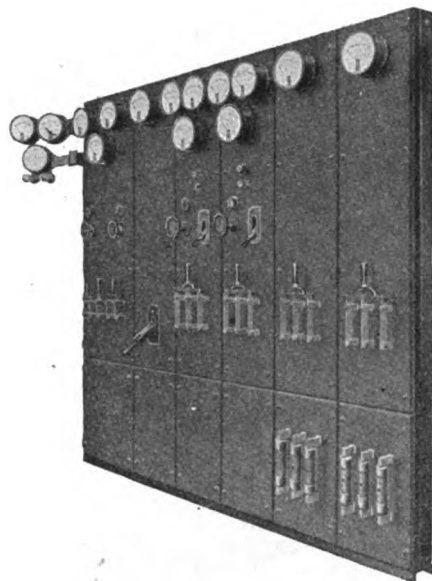
**General Description**—The quality of the apparatus provided is of the best. Seven-inch D'Arsonval round-type ammeters and voltmeters, type A knife switches, and type CA carbon circuit-breakers are regularly furnished with these panels. The carbon breakers are mounted on the upper section of the panel, and are operated from an operating handle similar to that used with an oil switch, the handle being mounted on the middle section, and connected to the oil circuit-breaker by means of the usual bell crank and connecting rod mechanism. A type A knife switch in series with the carbon breaker is mounted on a small panel supported from the panel framework on the rear of the board. The knife switch is operated from a handle identical in appearance, location and method of operation, as the carbon breaker. Large barriers are installed between the carbon breakers on adjacent panels providing ample insulation distances.

A wiring diagram, showing complete connections, is supplied with each switchboard.

Further information will be furnished on request.

## TYPE EA SWITCHBOARD PANELS

For 240—480-Volt Alternating-Current Service



TYPE EA SWITCHBOARD

**Application**—Type EA switchboards are designed to control the alternating-current electrical equipment of industrial plants and small central and distributing stations where voltages are not over 480. They are applicable where service conditions permit the use of knife switches and enclosed fuses, and where the cost of a switchboard with oil circuit-breakers is not justified.

**Capacity**—The capacity of a single generator panel is limited to 1000 amperes, a single feeder circuit to 600 amperes, and a complete switchboard composed of these panels should have sequence of panels arranged to keep bus capacity within approximately 2000 amperes.

Where currents above these limits are involved special designs are usually necessary.

Where higher voltages than 480 are involved types EB, EC, EH, or EE switchboards should be selected, although switchboards of the type EA construction can be supplied for 600-volt service on special order.

**Panel Construction**—Each panel consists of two sections, 2 inches thick with  $\frac{1}{4}$ -inch bevels. The lower section is 25 inches high and the upper section is 65 inches high. The panel is mounted on type E angle-iron frame with channel iron base, and the total height of the panel including the base is 92 inches.

**General Description**—The quality of the apparatus provided is of the best and conforms to the well known Westinghouse standard of excellence.

All indicating meters are of the well known 7-inch diameter type of highest grade, highly damped, accurate and with long open scales, making them more easily read than any other type. They can be supplied with either white or black dials.

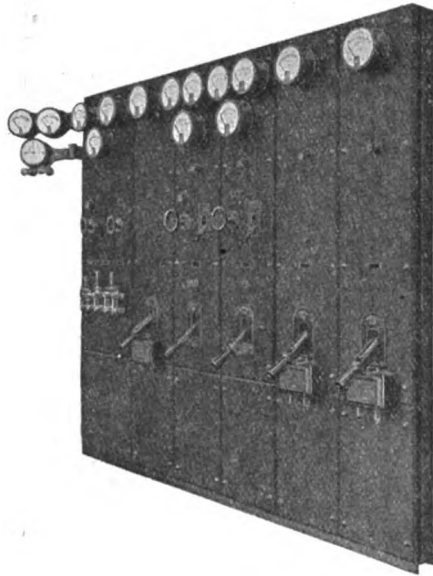
Type A knife switches are furnished with standard panels. Enclosed fuses provide automatic overload protection for the feeder circuits. All fuses supplied are of the enclosed type.

A wiring diagram showing complete connections is supplied with each switchboard.

Further information will be furnished on request.

## TYPE EB SWITCHBOARD PANELS

For 2400-Volt Alternating-Current Service Employing Hand-Operated Panel-Mounting Oil Circuit Breakers



TYPE EB SWITCHBOARD

**Application**—Type EB switchboards are designed to control the alternating-current electrical equipment of industrial plants and central and distributing stations, not exceeding 3000 kv-a. capacity and 2400 volts.

This type of construction is advisable for simple installations, where the oil switching devices are small and a very extensive switching equipment is not required. In considering the type of switchboards to apply, it should be remembered that good engineering avoids the crowding of apparatus and provides for large insulation distances. This point, which is kept foremost in Westinghouse panel design, contributes to the safety of attendants who must remove oil tanks, replace fuses, or do other work on the rear of the board.

Additional advantages in construction can often be obtained by the use of breakers mounted on panel frame work.

Where space on the rear of panels is limited, and it is desired to gain more accessibility at a limited expense, type EC construction with wall-mounted apparatus is recommended.

**Capacity**—The capacity of the individual generator or feeder circuits, where panels are to be incorporated as part of a type EB switchboard, is limited to 800 amperes, and that of a complete switchboard composed of these panels, to 2000 amperes in any section of the bus-bars.

**Panel Construction**—Each panel consists of two sections, 2 inches thick with  $\frac{1}{4}$ -inch bevels. The lower section is 25 inches high and the upper section 65 inches high. The panel is mounted on type E angle iron frame with channel iron base and the total height of the panel including base is 92 inches.

**General Description**—All indicating meters are of the well known seven-inch diameter, round type, of highest grade, highly damped and accurate, with long open scales, making them more easily read than any other type. They can be supplied with either white or black dials.

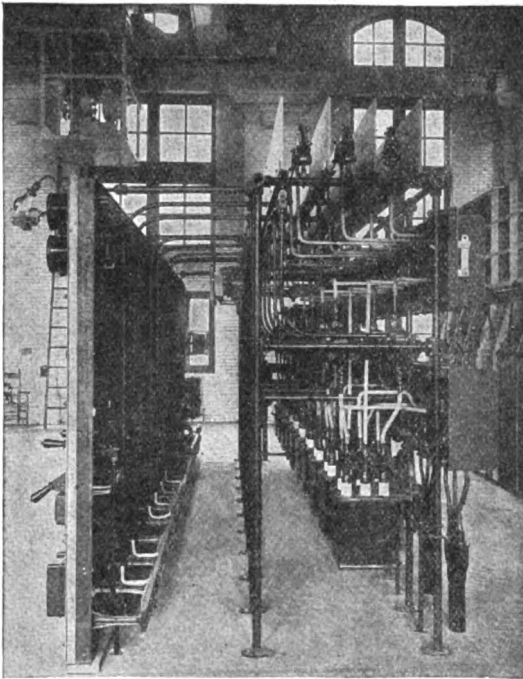
Automatic overload protection is provided for the feeder circuits. The oil circuit-breakers furnished with this class of panels are the type F.

A wiring diagram showing complete connections is supplied with each switchboard.

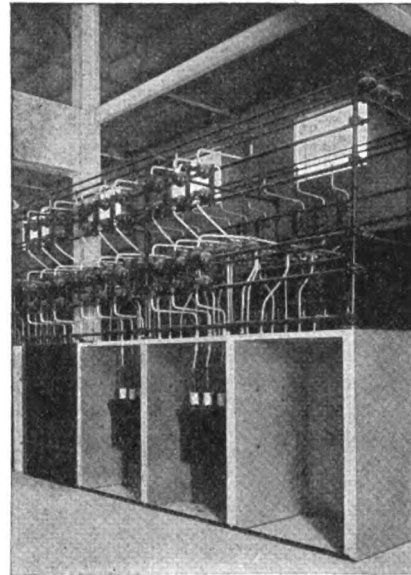
Further information will be furnished on request.

## TYPES EC AND EH SWITCHBOARD PANELS

For Moderate Capacity Alternating-Current Systems Employing Remote Hand-Operated Oil Circuit-Breakers



TYPE EC SWITCHBOARD CONSTRUCTION—WITH PIPE-FRAME-MOUNTING OIL CIRCUIT-BREAKERS



TYPE EH SWITCHBOARD CONSTRUCTION—WITH CELL-MOUNTING OIL CIRCUIT-BREAKERS

Types EC and EH switchboards are essentially the same as type EB as far as front appearance of the switchboard panels themselves are concerned. The same high grade instruments are furnished, and panel construction is the same, the chief difference being the method of mounting the oil circuit-breaker equipment. With the type EC construction, the oil circuit-breakers are mounted on pipe-frame-work, and with the type EH construction, the oil circuit-breakers are arranged for cell-mounting.

**Application**—The electrical limitations in applying these EC and EH switchboards are 240 to 13,200 volts for generator panels, 240 to 50,000 volts for feeder panels, and a maximum capacity of 2000 amperes in any section of the main bus-bars.

The mechanical limitations in applying these switchboards are:

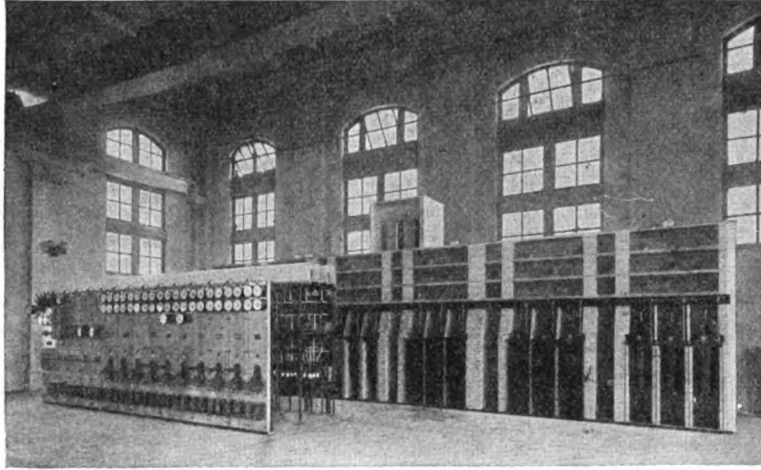
- (a) The distance between the switchboard panels to the corresponding oil switching device.
- (b) The power required to operate the switching devices through the system of bell cranks and connecting rods.

In general the total length of operating rods should not exceed 50 feet. For plants where the arrangement of the station requires a greater length of operating rods, and for larger plants and heavier capacities, electrically-operated apparatus is recommended, as covered by the type EE switchboards.

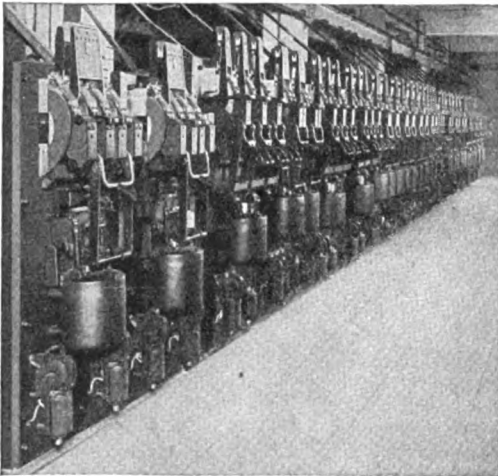
Further information will be furnished on request.

## TYPE EE SWITCHBOARD PANELS

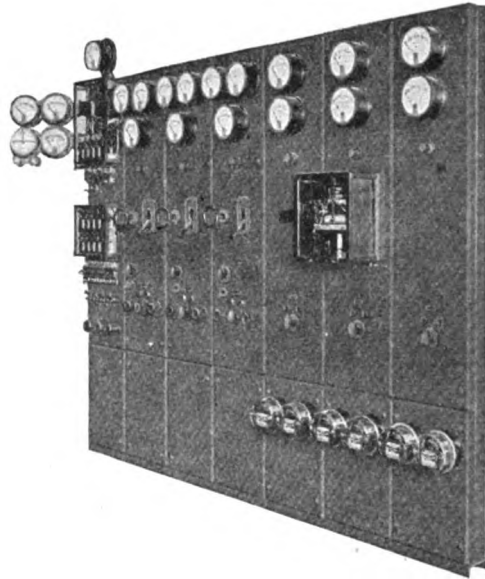
For Large Capacity Alternating-Current Systems Employing  
Electrically-Operated Oil Circuit Breakers



THE STRUCTURE IN THE BACKGROUND SHOWS A TYPICAL ARRANGEMENT USING CELL-MOUNTED OIL CIRCUIT-BREAKERS



ELECTRICALLY-OPERATED HEAVY CAPACITY TYPE CA CARBON CIRCUIT-BREAKERS



TYPE EE SWITCHBOARD

**Application**—Type EE switchboards are designed to control the alternating-current electrical equipment of central and distributing stations and industrial plants. They are applicable for station capacity or voltages so high as to make it desirable to mount the switching equipment apart from the panels and where the station arrangement necessitates the use of electrically-operated oil circuit-breakers.

Electrically-operated switchboards are also used

for the control of heavy capacity direct-current carbon circuit-breakers.

**Apparatus**—The instruments, relays, oil circuit-breakers, instrument transformers, disconnecting switches, etc., are of the highest grade of their respective kind.

A wiring diagram showing complete connections is supplied with each switchboard.

Further information will be furnished on request.

2-173A

## TYPES JD AND ED EXCITER AND VOLTAGE REGULATOR PANELS

For 125- and 250-Volt Exciter Circuits



TYPE JD EXCITER PANEL  
For One Exciter.



TYPE ED EXCITER PANEL  
For Two Exciters.

**Application**—These panels are for the control of the exciters used with alternating-current generators and are essentially the same as other two-wire direct-current generator panels except that no automatic protection is provided. Panels are also included suitable for Westinghouse generator voltage regulators, either with or without control for motor-driven exciters. They are designed to match and form a part of the standard alternating-current switchboards.

**Panel Construction**—Each type JD panel consists of a single slab 48 inches high,  $1\frac{1}{2}$  inches thick, with  $\frac{1}{4}$ -inch bevels on front edges, mounted on a type J switchboard pipe frame. The total height of the panel is 76 inches.

Each type ED panel consists of two sections, 2 inches thick with  $\frac{1}{4}$ -inch bevels on front edges. The lower section is 25 inches high and the upper section 65 inches high. The panel is mounted on a type E angle-iron frame, with channel-iron base. The total height of panel including the base is 92 inches.

**General Description**—The apparatus included

for these panel equipments is of the highest grade. The instruments are the seven-inch diameter operating on the D'Arsonval principle. Knife switches are the type A with plain break. Standard practice in supplying switchboard apparatus for control of exciter circuits is to furnish non-automatic switching devices. Where exciters are driven by alternating-current motors, the automatic circuit-breaker in the motor supply circuit will be furnished with a high overload setting. This practice is justified both because contrary practice would jeopardize the continuity of the alternating-current service, and because modern exciting apparatus is very reliable.

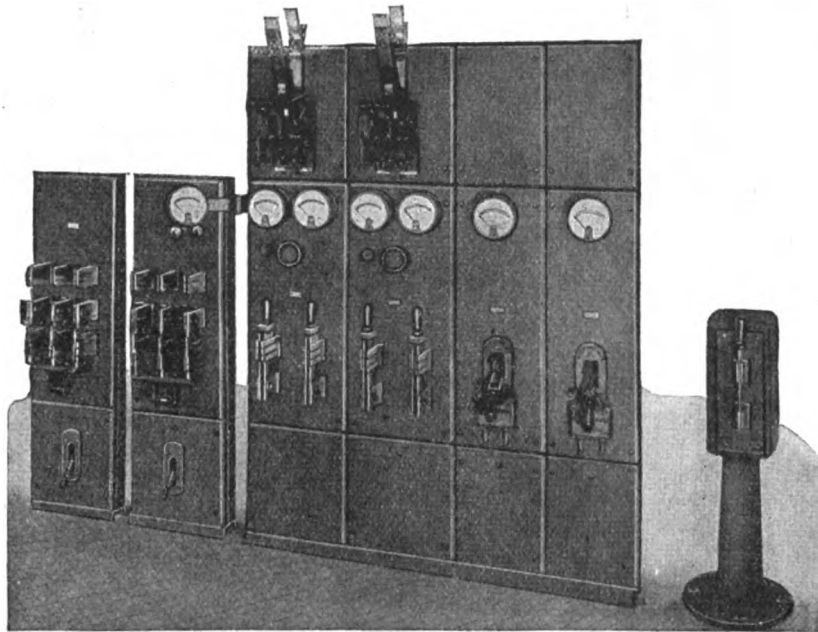
However, if, in the judgment of a purchaser, special conditions make it necessary to provide automatic protection in an exciter circuit, the Company is prepared to supply suitable devices on request, even though at variance with its usual recommendations and practice.

A wiring diagram showing complete connections is furnished with each switchboard.

Further information will be furnished on request.

## TYPES GC AND GE SYNCHRONOUS-CONVERTER SWITCHBOARD PANELS

For 6-Phase Compound-wound Synchronous Converters—4000 KW Maximum,  
600 Volts—2000 KW Maximum, 250 Volts—Direct Current  
For 6-Phase Synchronous Booster Converters—16,000 Maximum  
D-C. Amperes at 250 or 270 Volts  
25 and 60 Cycles



TYPICAL SYNCHRONOUS CONVERTER SWITCHBOARD

**Application**—These panels are designed for controlling the alternating current side of Westinghouse commutating-pole synchronous converters. They match up with and present a uniform appearance when made a part of the standard 90-inch alternating-current or direct-current switchboard. This line of panels includes designs for the complete line of Westinghouse six-phase converters of the maximum ratings given above, and contemplate the use of both hand and electrically operated oil circuit-breaker equipments on the a-c. side for the protection of the step-down transformer and the converter.

**Apparatus**—Seven-inch meters with long scales, full open face and deadbeat characteristics are regularly furnished. Power-factor meters are supplied with the standard compound-wound synchronous converter equipments, and reactive component meters with standard shunt-wound synchronous booster converters.

These meters are single phase since the phases of converters are practically balanced.

The knife switches are type A and are furnished with round studs up to 1200 amperes d-c. and 1100 amperes a-c. and with laminated studs for higher capacities. Laminated stud switches have the latest design pressure-moulded studs of hour-glass cross-section; the former insuring high and dependable conductivity and the latter ample radiation surface. Studs will be furnished with either vertical or horizontal laminations or a combination of both as may be required.

Oil circuit-breakers are of the standard types as required for the various commercial voltages,—either hand or electrically operated, and arranged for either wall or frame mounting.

A wiring diagram showing complete connections is supplied with each switchboard.

Further information will be furnished on request.



## AUTOMATIC SWITCHING EQUIPMENT

### AUTOMATIC SWITCHING FOR RAILWAY SUBSTATIONS

Automatic switching equipments have been designed to meet any requirement of substation operation in the electric railway field. Westinghouse automatic substations are furnishing power for every class of electric traction from the trolley bus and safety car at one extreme, to heavy steam railroad electrification at the other. Standard equipments can be supplied for 300, 500, 750, 1000, 1500 and 2000 kw. units up to 1500 volts. Any number of units in one station may be controlled, although it

is not usually good economy to make automatic a station with more than two units. Equipments for any size machine at any voltage can be supplied on special order.

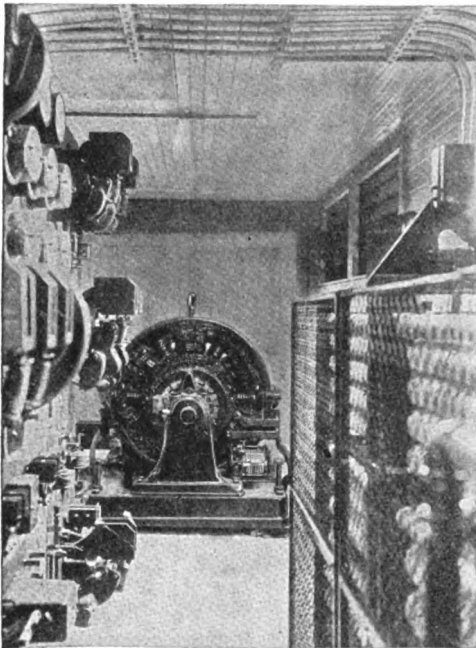
Westinghouse automatic switching is designed to function only in response to changes in the electrical condition of the machines or circuits to which it is connected. No essential operation is dependent upon fixed mechanical timing.

Protective equipment is provided to guard against single or reverse-phase starting, single-phase operation, short circuits, continued overloading, over speed, open field, low a-c. voltage, hot bearings, failure to rotate and reverse current.

The starting operation may be initiated by low trolley voltage, time switch, remote control by pilot wire, or remote supervisory control over the telephone line. In stations with two or more units, successive machines are brought into service as the load on the first machine increases, the first machine being started by one of the above mentioned methods.

For use with converters where heavy accelerating peaks must be handled, a load limiting resistance in one or more steps, is supplied depending on conditions. Where there are no heavy drains on small machines, this is unnecessary and the d-c. end is connected to the trolley through a service-restoring contactor which opens only on very heavy overload or short circuit, and which recloses when the heavy load or short circuit is removed.

Automatic control of the generator voltage provides effective means for controlling the load on motor-generator sets although for some applications this is unnecessary, in which case some load limiting resistance may be used, or the generator may be connected to the line by means of a service-restoring contactor.



INTERIOR OF 500-Kw., 600-VOLT D-C. PORTABLE RAILWAY CONVERTER SUBSTATION

### AUTOMATIC SWITCHING FOR HYDRO-ELECTRIC GENERATING STATIONS

Automatic control can be applied to any hydro-electric generating equipment without regard to size, type or head of water. It is ideally suited, however, to the smaller sizes up to 5000 kv-a. It makes possible the utilization of many small water power plants that could not be profitably operated if burdened with operating labor charges. The equipment can be supplied to start a generating unit:

1. By means of push button control from a distant station.
2. By means of supervisory control equipment operated from a distant point over a telephone circuit.
3. When the line frequency lowers.

4. When the available head of water exceeds a given height.

5. When the load on other generators exceeds their rating.

Where the capacity of the unit is not too great a percentage of the total capacity of the system, it may be connected directly to the line unexcited without synchronizing, provided that it is within 10 per cent of synchronous speed. For this class of service the generator must be equipped with damper windings such as would be used in a self-starting synchronous motor.

Where the machine characteristics are such as to prevent the use of the foregoing scheme, an automatic synchronizing equipment is provided which

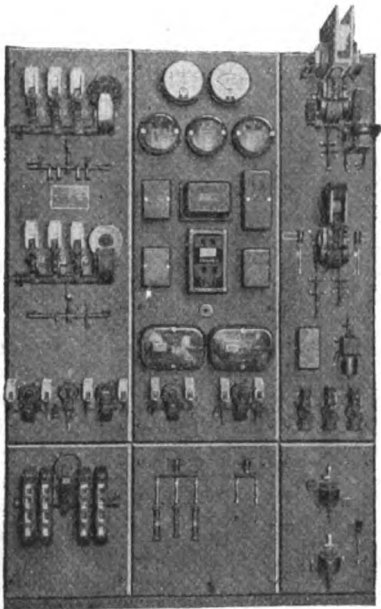
## AUTOMATIC SWITCHING EQUIPMENT—Continued

regulates the wheel speed and closes the breaker at the first favorable point of synchronism.

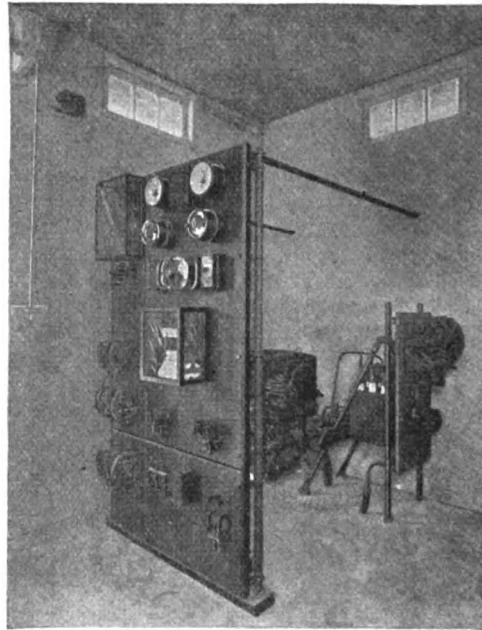
It is very essential that the water wheel governor be equipped for automatic operation by the manufacturer of the particular governor in question. Automatic operation may also be had with electrically-operated gates if battery energy is available or if the unit is never to be started with the line voltage below 60 per cent of normal. Automatic control of the electrically-operated gate is available for holding a constant level of head water until the stream flow exceeds the wheel capacity.

The load may be controlled, and various readings taken in the station, by remote control as described on a following page.

Protection is provided against continued over-



AUTOMATIC SWITCHBOARD FOR LIGHT TRACTION



AUTOMATIC SWITCHBOARD FOR THE CONTROL OF A 187-KV-A. 2400-VOLT, 3-PHASE, 180 RPM., WATER WHEEL GENERATOR

loading by means of thermal relays. A line voltage relay trips the unit out in case of a bad short circuit and restores the unit to service when the line potential rises to such value as to indicate that the trouble is cleared. Bearing thermostats are provided to shut down the unit should the bearings overheat. Where the size, or voltage of the generator warrants the added expense, differential protection may be included. Overspeed protection may be added if wanted.

For stopping the unit in case of gate leakage, both air and oil brakes are available. Oil brakes are usually preferred as the oil under pressure may be obtained from the governor tank. Inquiries for this class of apparatus should be made on form 9278.

## REMOTE SUPERVISORY CONTROL SWITCHING

The automatic telephone industry has developed, to a high state of perfection, the art of selective control over one pair of wires. These same principles and methods are applicable to the control of power apparatus at a distance.

Many possible combinations may be used. The most simple of these is the one developed for the control of a number of small hydro-electric generating stations over one pair of telephone wires which are also used for conversation.

The despatching end consists of a dial such as is customarily used on an automatic telephone, a telephone receiver and a line key. The receiving apparatus is an assembly of standard telephone

switchboard relays and rotary switches. To communicate with any particular station, the dispatcher closes the line key, dials the number of the station and then listens. A bell at the distant point taps the station number which may be heard by the dispatcher in the telephone receiver. The number of the desired operation is then dialed. If the desired operation is a report on the available head of water, the distant equipment operates in such a manner as to send out a series of buzzer notes, each note indicating one tenth of the total head. The dispatcher counts the number of buzzer notes and from a table reads the height of water. In like manner, the gate position may be ascertained. The

## AUTOMATIC SWITCHING EQUIPMENT—Continued



DIALING AND SENDING APPARATUS

unit may be started or stopped, or the generator setting changed by the calling of various code numbers.

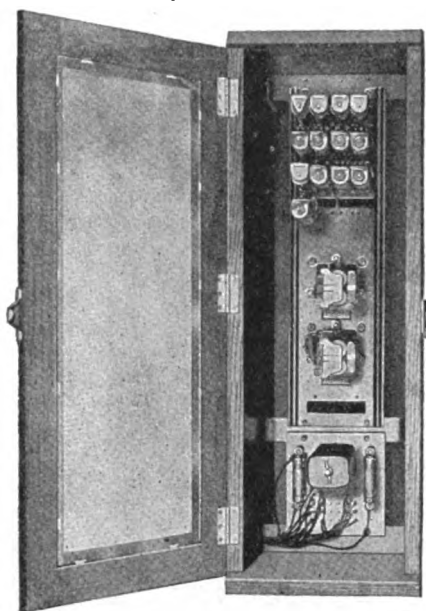
A more elaborate system may be had which furnishes the dispatcher a small control switch for each operation and which provides a return signal which operates colored lamps in a manner similar to standard switchboard practice. This system may be operated over only two wires, if a delay in the answering signal is permissible. If rapid answering signals are desired, a third wire is necessary, or where conditions permit, the ground may be used. This system, using rapid answering signals, appeals to operating men accustomed to the use of electrically controlled breakers because of the similarity of operation. Of course the elaborate system is very much more expensive than the first mentioned.

For complex systems where there is not sufficient

room for one key for each operation, a keyboard similar to an adding machine may be used.

Equipment is also available for the transmission of load indications by means of impulses. The local circuit at the receiving end may be connected to demand, recording, integrating, or indicating meters as desired. These meters will record with almost as great accuracy as though installed in the same station with the instrument transformers.

Complete control and supervision of a substation from a central point can be had by using four wires. These wires will carry the actual control of all circuit breakers or other apparatus, the answer-back lamp signals, the load indicating device, and a telephone circuit.



RECEIVING APPARATUS AT SUBSTATION

### AUTOMATIC TRANSFORMER AND A-C. FEEDER SWITCHING EQUIPMENT

Westinghouse switching equipment is now available for all forms of automatic transformer and alternating current feeder switching. Substations for this class of service may vary from the automatic equipment for reclosing a small number of feeders to that required for automatically switching one or a number of transformers or transformer banks, or for any combination of such equipments.

Transformer switching equipment may be applied to one or a number of transformers or transformer banks according to any one of the following examples:

1. One transformer to be switched on or off according to a predetermined schedule; that is, a transformer may be switched on at the time the peak load occurs, and switched off at the time corresponding to the cessation of that load.

2. One transformer to be used to reinforce the low tension distribution system, being switched on as the voltage falls on account of increased load and switched off at the cessation of this load.

3. Two transformers to be operated at different times, the larger transformer handling the load during heavy load periods, and the smaller transformer replacing it at periods of light load, thus reducing the transformer operating loss.

4. Two transformers to be operated separately or combined, the one acting as a spare or auxiliary to the other.

5. Two transformers or more to be operated in accordance with load demands, in such a way that one or more transformers may be switched on as the load increases and in turn switched off as the load decreases.

**AUTOMATIC SWITCHING EQUIPMENT—Continued**

In any system of transformer switching, complete protection must, of course, be given to the transformers against overheating, burn-outs, etc. Such protection should be in the form of a lockout so that the occurrence of such a condition will necessitate the inspection by an operating man and a subsequent hand reset of the lockout relay before such a transformer can again come into operation.

Protection to the transformers should include:

1. Protection against overload by suitable switching devices.
2. Protection against overheating by suitable thermal relays.
3. Protection against low voltage.

In addition, it may be desirable to protect the transformer against internal faults by suitable differential relays.

### Automatic A-C. Feeder Switching Equipment

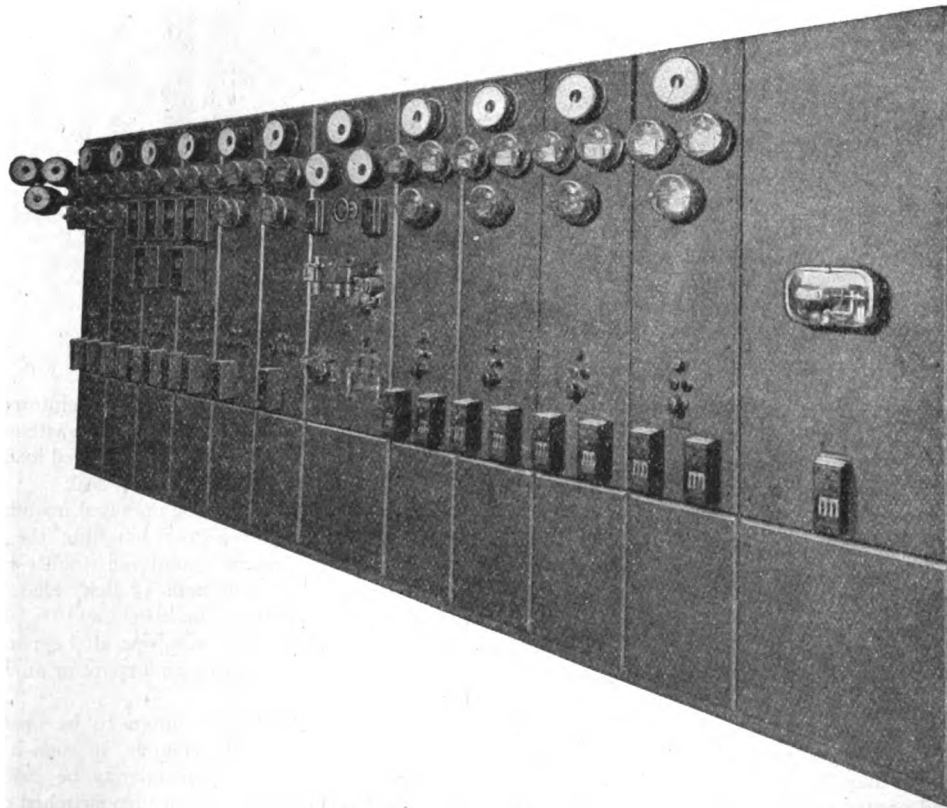
The general scheme of automatic alternating-current feeder switching equipment, as developed by the Westinghouse Company, is based on the automatic reclosure of alternating current feeder breakers a certain predetermined number of times with various time-intervals between these reclosures; these time-intervals being based on the conditions involved. If the fault persists and trips

the breaker out its full number of times, the breaker is locked out and will not be reclosed until after the resetting of the lockout device by an operator. The opening of the breakers is independent of the automatic reclosing relay equipment, and may be effected by ordinary overload tripping with or without time element relays, by low voltage, or in fact any arrangement which the purchaser may desire.

The Westinghouse Company has perfected four general schemes of automatic alternating-current reclosing equipment as follows:

1. Service Restoring.
2. Periodic Reclosing.
3. Combined Service Restoring and Periodic Reclosing.
4. Periodic Reclosing with Selective Action.

Scheme 1, Service Restoring, is arranged to automatically reclose a feeder breaker after tripping out as rapidly as the mechanical features of the breaker will allow. This rapid sequence of reclosing will continue for a predetermined number of times as long as trouble remains on the outgoing feeder. A limiting relay locks out the equipment after a predetermined number of operations, usually three. Should the trouble clear before the full three operations have taken place, the breaker will remain closed and the relay equipment returns to the original position ready for future operations. This scheme is generally used only where it is de-



**AUTOMATIC PERIODIC-RECLOSEING EQUIPMENT WITH SELECTIVE ACTION FOR FEEDERS (SCHEME 4)**

## AUTOMATIC SWITCHING EQUIPMENT—Continued

sired to hold synchronous loads in step. The duty imposed on the breaker is exceptionally severe, and consequently a much heavier breaker is required than with schemes employing a longer time interval between reclosures.

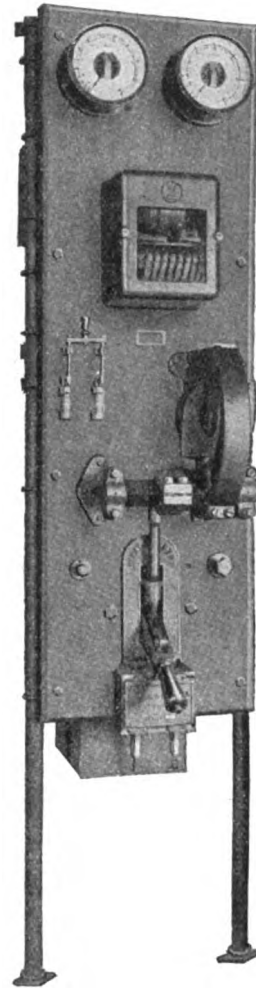
Scheme 2, Periodic Reclosing, operates in a similar manner to scheme 1, except that a definite time interval is interposed between the breaker reclosures. This time interval is accomplished by means of a motor-operated relay which has been developed to give time intervals of either  $\frac{1}{2}$ , 1 or 2 minutes. These different time-intervals can all be obtained on the same relay by means of a very simple interchange of gears supplied with the equipment. A similar relay can also be supplied, if desired, to give intervals of 1, 2 or 4 minutes. The duty imposed on the breaker with this scheme is much lighter than with scheme 1 and approaches the basis on which breakers are rated.

Scheme 3, Combined Service-Restoring and Periodic Reclosing, is a combination of the above two schemes. By means of an overload selective relay, a distinction is made between ordinary overloads and exceptionally heavy overloads or short circuits. Under ordinary overloads the service-restoring relay equipment will function to close the breaker as rapidly as possible; for heavy currents or short circuits the overload selective relay will operate and set the periodic reclosing equipment into operation. This scheme, although reducing the heavy duty imposed by the straight service-restoring equipment, is somewhat more expensive than either schemes 1 or 2, and is not recommended except for special application.

Scheme 4, Periodic-Reclosing with Selective Action, has been designed for adaptation to feeder stations having a number of feeder breakers all of which close from the same power source. Obviously it would not be desirable to close a large number of breakers all at the same instant, both on account of the closing power taken from a battery or small operating transformer, and on account of the shock to the power supply system that would be caused by the simultaneous closing of a large number of feeder breakers particularly in case of continued trouble. Scheme 4, therefore, operates on practically the same principle as scheme 2, except that a selective sequence relay is added to prevent more than one breaker closing at a time. Should more than one breaker pull out at the same time, the selective relay will set itself for one breaker and that breaker will go through its reclosing cycle, either locking out or remaining closed, depending upon the persistence of the feeder trouble. After the first breaker cycle has been completed, the selective relay will set up the reclosing equipment for the next feeder, and so on until all the opened feeder breakers have either been closed or locked

out. With this scheme, battery control is generally used. We are prepared to supply automatic battery charging equipment in addition to the reclosing equipments.

All negotiations pertaining to automatic switching equipment, as indicated above, should be referred



AUTOMATIC PERIODIC-RECLCING EQUIPMENT FOR SINGLE FEEDER (SCHEME 2)

to East Pittsburgh for further information. With the negotiation should be forwarded the following:

Kv-a capacity of the system, including the maximum short circuit current to be interrupted by the breakers concerned.

Method of control, a-c. or d-c.

Type of service, that is, single-phase three-phase, or three-phase four-wire etc.

Whether hand control is to be included with the automatic control.

Desired time-intervals between reclosures.

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS

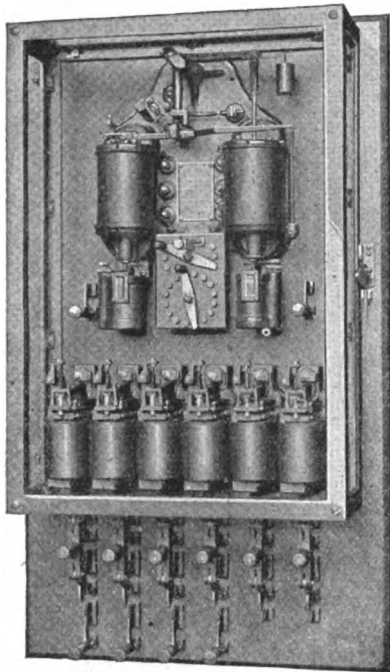


FIG. 1—TYPE AB-4  
GENERATOR VOLTAGE REGULATOR

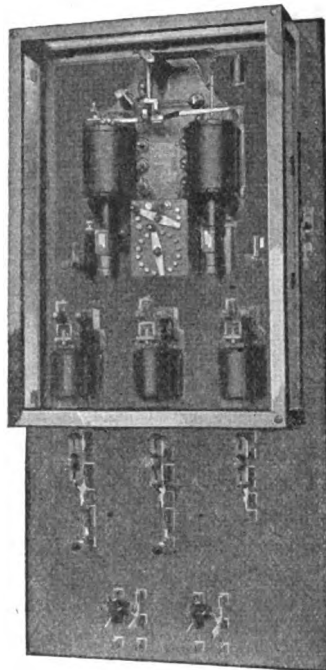


FIG. 2—TYPE AL-2  
GENERATOR VOLTAGE REGULATOR

### AUTOMATIC GENERATOR VOLTAGE REGULATORS

The problem of voltage regulation on constant-potential circuits is one of considerable importance, chiefly because of the necessity of giving satisfactory service to the customers of operating companies. Inadequate voltage regulation reduces the quality of the service and, consequently, its commercial value.

The operating company is no longer purely a lighting company, but largely power and lighting, hence, the regulation of generator voltage has become more difficult. The necessity of using an automatic voltage regulator is increased by the fact that the present design of alternating-current generators, for reasons of economy, gives poor inherent regulation. The voltage regulator automatically maintains the system voltage at a value that results in a steady voltage at the required point, a result that is obviously impossible of accomplishment by hand.

Two distinct types of voltage regulators have been developed to meet most satisfactorily the various problems of adequate voltage regulations. One is the well known vibrating-type of voltage regulator, the other is the unique and remarkable rheostatic-type of voltage regulator. Although both regulators have the same field of application, there is a more or less natural selection for the two kinds.

For generators of medium capacity up to approximately 10,000 kv-a. with the excitors of fairly high speed, the vibrating-type of regulator will generally be found the most economical.

For generators of large capacity with excitors also large and of slow speed, the rheostatic-type of regulator is better suited.

For special conditions to be met such as excitation values below the residual voltage of the excitors, or for general power load to be taken from the excitation systems, the rheostatic-type of regulator should be applied.

**Alternating-Current Regulators** — The various uses to which alternating-current voltage regulators are best adapted fall into the following divisions: (a) the maintenance of constant voltage at generator, bus, or some predetermined center of distribution; (b) the maintenance of constant voltage at the end of transmission lines by the control of synchronous condensers or synchronous boosters; (c) the control of booster-type rotaries; (d) the control by special regulators of synchronous condensers applied to local network or distributing systems for voltage regulation and power factor correction; and (e) the maintenance of constant current instead of constant voltage.

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

**Direct-Current Regulators**— The application of direct-current voltage regulators is very much limited and should be made with the greatest of care. It is confined to the maintenance of constant voltage on direct-current generators where the plant is used for power purposes only, and to the maintenance of constant current.

Where a direct-current plant is too large for the limited capacity of the d-c. regulator, a d-c. regu-

lator made similar to the alternating-current type may be used to control one or more exciters for the plant. This application is suitable for a mixed power-and-lighting service.

A modified type of the d-c. regulator can be applied to flywheel motor sets, and thereby limit the maximum current drawn from the supply source to a predetermined value.

## VIBRATING-TYPE VOLTAGE REGULATORS

**Method and Principle of Operation**

Westinghouse voltage regulators for alternating-current generators regulate the generator voltage indirectly by varying the exciter voltage.

Referring to Fig. 3, the main control magnet has its core attracted upward. Its core stem is connected to the floating lever, which is pivoted to the bell-crank lever of the vibrating magnet. A counterweight is used to assist the pull of the main control magnet, and to bring the lever and core to a balanced position at the normal voltage to be regulated. The vibrating magnet also has its core attracted upward. Its core stem is connected to one end of the bell-crank lever which is pivoted to the base, and its opposite end carries the floating lever of the main control magnet. The pull of this vibrating magnet is assisted by a single spring as shown. These two magnets are energized from the same voltage transformer, and actuate the movable main contact into and out of engagement with the fixed contact.

An inspection of schematic diagram, Fig. 3, shows that the closure of the main contacts causes all relay contacts to close. One of the relays, called the vibrating relay, is connected so that the closure of its contacts shunts a small portion of the resistance in series with the vibrating magnet, thus increasing its pull and opening the main contacts. The opening of the main contacts opens all relay contacts and inserts the full resistance in the vibrating magnet circuit, weakening the pull and closing the main contacts again.

From the above cycle, it is seen that for any given position of the floating lever, a condition of continuous vibration results. A necessary condition to the continuous vibration of the system is that the weight of the vibrating magnet core and lever must be exactly balanced by the tension of the control spring and average pull of the magnet. Any change in the tension of the control spring results in an equal change in the average magnet pull. For a given line voltage there is a definite magnet pull when the contacts are closed, and a definite pull of less value when the contacts are opened. The average magnet pull must be a function of the time of the contact engage-

ment. For any given position of the floating lever, there is a corresponding position of the bell-crank lever and tension of the control spring. However, on account of the balanced condition there must be a corresponding average magnet pull and time of contact engagement.

The rheostat-shunting relay contacts open and close across the shunt field rheostat of the exciter, and the effective resistance of the rheostat is determined by the time of contact engagement. For any effective resistance, there is a corresponding exciter voltage, and, therefore, a-c. voltage.

The time of contact engagement, as used here, means the ratio of the time the contacts are closed to the total time for opening and closing.

As the control element is energized from the a-c. generator the main control magnet will assume a position such that a time of contact engagement is maintained sufficient to develop an exciter voltage and therefore an a-c. voltage capable of balancing the core weight. Any variation in line voltage changes the position of the floating lever in such a manner as to vary the excitation and restore the balance.

In the standard range regulator, the rheostat-shunting relays are energized from the exciter circuit.

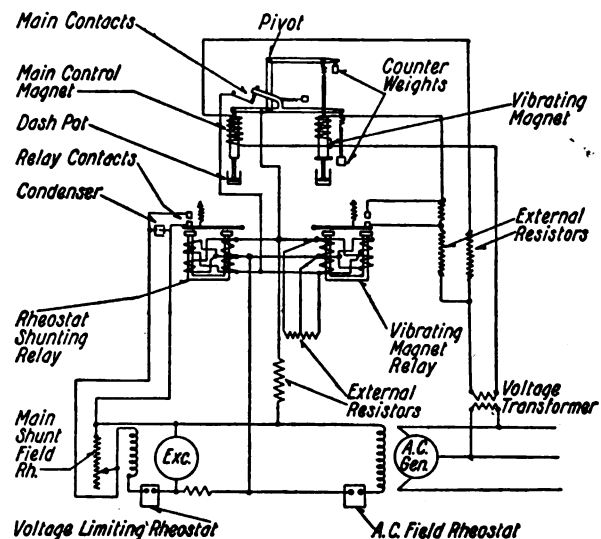


FIG. 3—SCHEMATIC DIAGRAM OF TYPE AB-1 REGULATOR

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

For the broad range regulator, the operation is similar to that of the standard range regulator, except that rheostat-shunting, vibrating, and master relays are energized from an independent source of direct current.

For self-excited direct-current generators, the rheostat-shunting relays operate directly on the generator-field rheostats, the control system being actuated from the direct-current mains through a suitable resistance.

For direct-current machines having a separate exciter, the rheostat-shunting relays operate on the exciter rheostat the same as in the alternating-current regulators.

### Construction

Westinghouse voltage regulators, arranged in a suitable case, are constructed for bracket, panel, or pedestal mounting, as required by installation conditions. Bracket-mounted regulators are provided with a standard black-marine slate base; or, if desired, with a blue Vermont marble base, at an increase in price.

The regulator parts are arranged in the case with the control system located in the upper part supported on a small cast base, and with the rheostat-shunting relays arranged in horizontal rows at the bottom. The control element and relays are self-contained units and either may be removed from the base without disturbing its adjustment.

Any size regulator can be designed to be mounted on a 16-inch panel. Where the number of rheostat-shunting relays exceeds ten, a second case containing relays only is supplied.

The control system for alternating-current and separately-excited direct-current generators consists of the main-control magnet and the vibrating magnet, with the main contacts between them. The magnets are of the solenoid type, and are very sensitive. They are provided with adjustable dash-pots to permit adjustment of regulation to suit the characteristics of the system.

One of the relays, called the vibrating-magnet relay, is used to govern the operation of the vibrating magnet. On the larger size regulators, one or more master relays are used to control a group of rheostat-shunting relays, thus relieving the main contacts of handling control currents beyond their capacity.

The use of the master relay is made possible by the alternating-current control and permits of the construction of regulators with as many as 40 rheostat-shunting relays. The master relay introduces no time lag in the response of the regulator, nor in the voltage regulation, since the vibrating-magnet relay and the rheostat-shunting relays operate simultaneously.

The control system of regulators for self-excited direct-current generators consists of a single solenoid actuating the main contacts, no vibrator being required. The rheostat-shunting relays are located in horizontal rows in the lower part of the regulator case.

The general appearance and finish of all regulators is in harmony with the highest class switchboard practice.

Disconnecting switches and transfer switches of improved design are located below the case.

### Application

The successful application of voltage regulators depends on several factors entirely independent of the size and design of the regulator itself. It is not only necessary that the regulator be properly designed, but it is also essential that the exciters, gen-

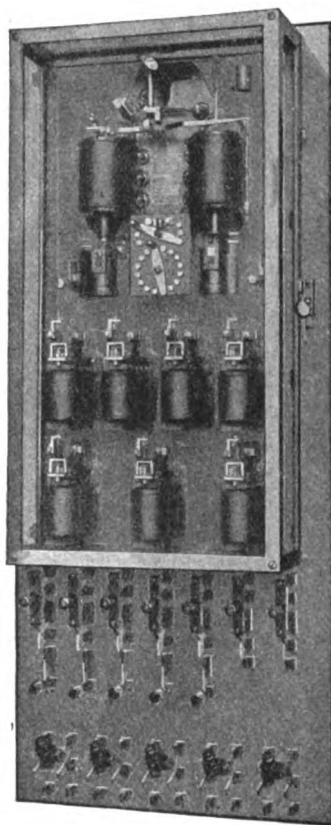


FIG. 4—TYPE AL-5  
GENERATOR VOLTAGE REGULATOR

erators, and prime movers possess characteristics that will harmonize with each other and will assist in keeping the voltage at the desired value under rapidly changing load conditions. In general, the following conditions should be approached as nearly as possible in order to obtain satisfactory results:

1. Prime movers must be provided with proper automatic governors that will respond instantly to changes in load and keep the speed reasonably constant (within 3 per cent to 4 per cent from no-load to full-load).
2. Alternating-current generators should have as nearly as possible the same percentage range of excitation from no-load to full-load.
3. Exciters must be capable of delivering sufficient voltage to take care of the alternating-current



## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

generator fields under full-load conditions, 80 per cent power factor, plus a certain additional voltage. This additional voltage above the steady exciter voltage required to maintain constant bus voltage under full-load conditions, is necessary in order that the regulator will continue to vibrate and thereby have control of the exciter.

4. Exciters (where more than one are to be considered) must be adjusted to operate in parallel under all loads and at any point on the saturation curve.

5. Exciters for 125-volt service should be able to build their voltage up or down between the limits of 30 and 125 volts in 5 seconds or less under load consisting of generator field circuits. The time-constant should be the same for exciters of other rated voltages over proportional ranges. Exciters with greater time-constants than this may not permit the regulator to maintain constant voltage with rapidly fluctuating load.

6. 125-volt interpole exciters must be able to develop at least 135 volts with the series winding disconnected, and should be so operated. The series winding must be cut out of circuit in order to secure a satisfactory time constant. In general, the exciter must be capable of developing a voltage 10 to 15 per cent in excess of that required by the a-c. generator at full load, 80 per cent power factor, the a-c. generator-field rheostat being adjusted so that with 60 volts on a 125-volt exciter the a-c. generator develops normal voltage at no load.

The question of the application of these regulators to generating stations required to operate in parallel should be referred to the Works, giving complete data on the existing or proposed system as indicated in the paragraph under Line Drop Compensation.

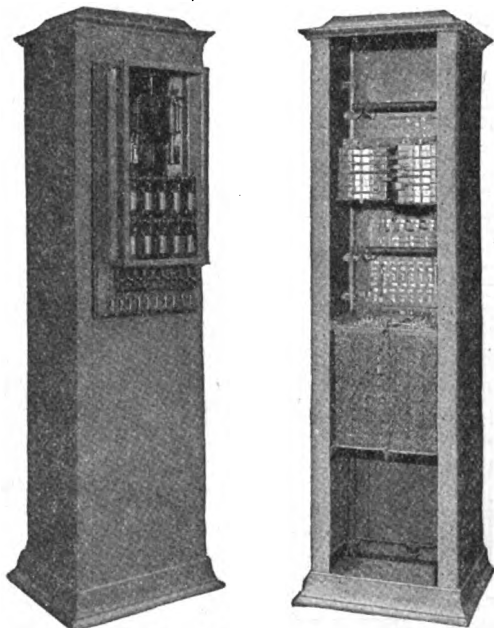


FIG. 5—TYPE A-C-8 VOLTAGE REGULATOR EXCITERS IN PARALLEL

On small systems, supplying a mixed lighting-and-power load, where induction motors are sometimes thrown directly on the line without starting devices, the momentary current required may be of such a value as to affect the feeder system and cause a noticeable flicker in the lights. Automatic regulating devices in the generating station cannot be made sensitive enough to prevent this effect under such conditions.

In generating stations having individual exciters it is recommended that one regulator be used with each machine. This arrangement is the unit system which makes each machine a complete power plant, lessens the liability of interrupted service, and increases the flexibility of the station.

It is only necessary to give each regulator a slightly drooping voltage characteristic with the reactive component of the load current to insure stability when regulators are operated in parallel.

#### Standard Range System

—The standard alternating-current generator-voltage regulators are adapted for voltage regulation of alternating-current generators requiring a nominal excitation range of either 45 to 135 volts, or 60 to 150 volts.

The 45 to 135-volt range being a 1 to 3 range permits full automatic regulation where the design of the alternating-current generator field requirements is extremely liberal.

Where 250-volt exciters are used, the range is from 120 to 300 volts or 1 to 2½.

**Broad Range System**—With the broad range system of regulation, full automatic voltage regulation can be obtained for all ranges of excitation. The standard regulator can be made broad range by energizing the relays from a separate source of direct current, such as a small motor-generator set or a storage battery.

The broad range system of regulation is directly applicable to synchronous condensers for maintaining voltage at receiving end of a transmission line by adjusting the wattless load of the synchronous condenser, either lagging or leading, as required.

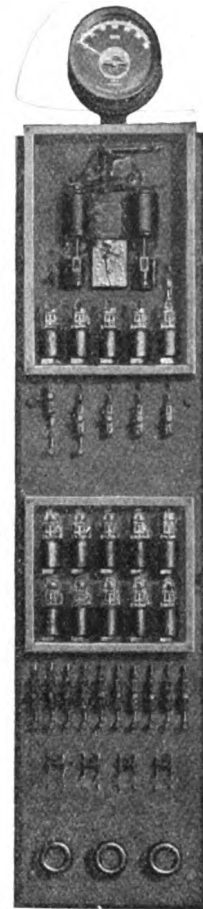


FIG. 6—TYPE AN-12 GENERATOR-VOLTAGE REGULATOR FOR CONTROLLING THREE EXCITERS, EACH CONNECTED DIRECTLY TO A GENERATOR WITH GENERATORS IN PARALLEL

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

**Single Operation of Exciters and Parallel Operation of Generators**—By the use of a control element energized entirely from the a-c. system of the operation of alternating-current generators in parallel with the exciters operating singly, has been made possible. The regulators for such service are equipped with special transfer switches so that the d-c. circuit for energizing the relays may be transferred to any exciter that may be in operation.

**Relays**—The number of relays for any given exciter may be approximated very closely where the speed (rpm.) and the kilowatt capacity is known.

For standard 125-volt, 1200-rpm. or higher speed exciters, one relay for every 25 kilowatts of exciter capacity and one condenser section per relay is required.

For standard 125-volt, 900-rpm. exciters, one relay for every 18 kilowatts of exciter capacity and one condenser section per relay is required.

For standard 125-volt, 600-rpm. exciters, one relay for every 12 kilowatts of exciter capacity and one condenser section per relay is required.

For slower speed exciters or for exciters of other than 125 volts, refer to Works with form 1046 completely filled out.

In addition to condensers for relays, note that one condenser section is required for every master relay used in connection with the larger size of regulators.

A closer check on the number of relays for a given exciter may be determined approximately as follows: With no load on the exciter, turn its field rheostat all out, thus giving a maximum armature voltage. Measure field amperes at this maximum voltage and allow 5 amperes per relay with one condenser section per relay. If field current exceeds 16 amperes maximum at 30 per cent above normal voltage, the case should be referred to the Works.

**Line Drop Compensation**

For complete line drop compensation it is necessary to consider two factors, namely, inductive drop and ohmic drop in the line and transformers between the generator bus and the distributing center. The inductive component of line drop is at right angles to the load current and is compensated for by introducing into the potential circuits of the regulator a voltage in phase with and proportional to the actual inductive drop. An external compensator, energized from series transformers, properly connected, accomplishes this purpose. This compensator is pro-

vided with adjustable dials by means of which the voltage introduced in the regulator circuits, for a given ampere load, may be varied, thus permitting adjustment for the percentage inductive load.

The ohmic component of line drop is in phase with the load current and is compensated for by energizing the current windings of the regulator coils from series transformers properly connected. The regulator control magnets are then affected by a magnetizing force which is in phase with the load current. The current windings on the regulator coils are divided into sections and connected to an adjustable dial. This provides a ready means of obtaining the proper percentage of ohmic compensation.

Figure 8 shows the connections to three-phase systems for this method.

To obtain complete line drop compensation it is necessary to adjust both the compensating devices to agree with the line characteristics. Where ohmic line drop compensation only is desired no external compensator is necessary. The current windings on the regulator coils, when properly energized from series transformers, accomplish this result. For three-phase systems, two current transformers in vector parallel are required for complete compensation. The connections are shown in figure 7. The transformers must be in the same legs of the circuit as those to which the voltage transformer is connected in order that the resultant current will be in phase with the voltage at 100 per cent power factor.

Partial ohmic compensation may be obtained on three-phase systems by energizing the current windings of the regulator coils from a single current transformer connected in one of the legs to which the voltage transformer is connected. With this method, the current from the current transformer is 30° out of phase with the voltage and will

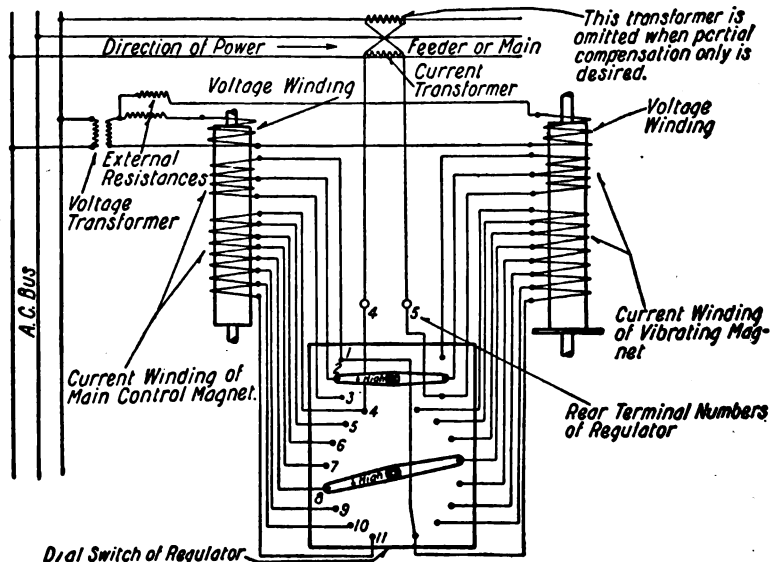
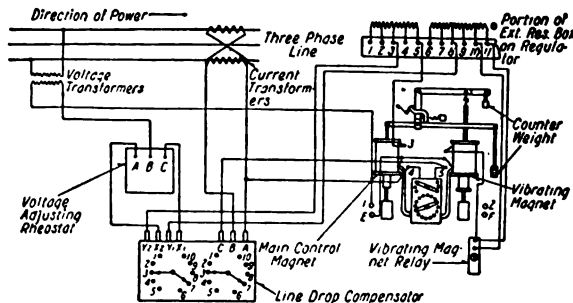


FIG. 7.—CONNECTIONS OF REGULATOR FOR OHMIC COMPENSATION ON 3-PHASE SYSTEMS

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued



The above connections are correct for a secondary operating voltage of 110 Volts. If a different operating voltage is required, refer to the diagram of connections furnished with the Voltage Adjusting Rheostat for the proper connections to the external resistor

FIG. 8—CONNECTIONS OF REGULATOR AND EXTERNAL COMPENSATOR FOR 3-PHASE SYSTEMS

therefore not give as accurate results as when two current transformers are used. This method is also indicated in Fig. 7.

In single or two-phase systems, ohmic compensation is obtained by energizing the current windings of the regulator coils from one current transformer connected in one of the legs to which the voltage transformer is connected.

When it is desired to correct for line-drop or power-factor changes by means of a separate line drop compensator in conjunction with the regulator outfit, information as to the equipment necessary should be secured from the Company.

When information is sent to the Company regarding line drop compensation, the following should be given: The approximate regulation of transmission line, at its rated capacity and zero power factor; length of transmission line, and capacity and number of stations; number of regulators to be applied and total capacity of transformer bank at each station that operates on the line.

**Parallel Operation of Regulators**—Where stations operate in parallel, and each is controlled by a voltage regulator, it is possible to compensate for the ohmic drop only, as inductive compensation destroys the stability of the system. The point in the system at which it is desired to maintain constant voltage should be specified in order to obtain proper compensation.

**Accessories**

**Condensers** are required for connection across the rheostat-shunting relays, to minimize the contact wear occasioned by the sparking incident to the opening of the shunt across the exciter field rheostat.

However, the state of the art is such that it is sometimes impossible to anticipate the proper number of condenser sections to apply for exciters of certain inherent characteristics.

This table is approximate. Actual operation must determine proper condenser capacity.

Exciter Full-Load Current at Full-Load Normal Voltage	No. of Condensers and Relays
1.5 amperes or less	2 condensers in series
1.5 amperes to 3.5 amperes	1 condenser
3.5 amperes to 5 amperes	2 condensers in parallel

**Voltage Adjusting Rheostats** — Taps are always provided on the external resistor whereby the volt-

age regulated can be varied from 98 volts secondary to 116, in steps of 6 volts.

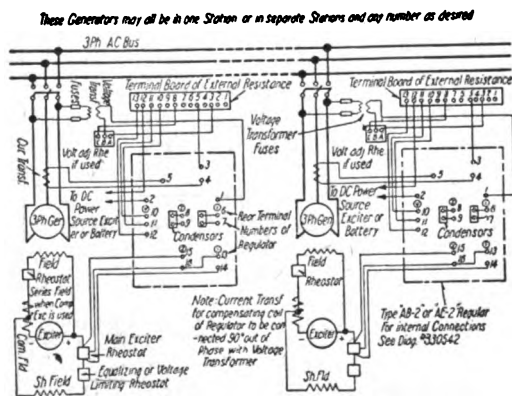
Where, for any reason, it is desired to vary the operating voltage of the system from time to time, a voltage adjusting rheostat should be used in the control-element circuits for the fine adjustment of voltage, instead of varying the counterweight. This rheostat has a sufficient resistance to give an adjustment of about 6 volts either way from the normal voltage when properly applied. The use of this rheostat is recommended in all applications, as it is a much more convenient and satisfactory method of adjusting the voltage while the regulator is in operation.

For the larger systems a rheostat having a range of 15 volts either way from normal can be supplied on special order.

**Exciter Rheostats**—When a regulator equipment is being added to a plant in operation, the existing exciter rheostats should be checked to determine whether they have sufficient resistance to permit of adjusting the exciter for the proper time constant.

They should have enough resistance to lower the exciter voltage from normal to 24 per cent of normal in four seconds. If this rheostat does not have sufficient resistance it can, in many cases, be used as the Voltage Limiting Rheostat, and a new main rheostat ordered.

**Auxiliary Exciter Rheostats**—Where two or more exciters, operating either singly or in parallel, are controlled from a regulator, the use of an auxiliary rheostat is required in the field circuits of each ex-



Where reactance between points regulated exceeds 8 per cent cross current, current transformers may be omitted.

FIG. 9—PARALLEL OPERATION OF GENERATOR-VOLTAGE REGULATORS

citer, to adjust the time constants and maximum voltage of all the exciters to the same values in order that they will carry their proper share of load.

Where only one exciter is controlled by a regulator the use of an auxiliary rheostat is not required unless too high a maximum voltage and, consequently, too large a field current, is obtained when the main exciter rheostat is short-circuited by the relay contacts.

**Voltage Transformers** — The regulator control element requires approximately 400 volt-amperes to

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

operate. Up to and including 4000 volts it is necessary to use one special 400-volt-ampere transformer as listed in this section or 2 standard 200-volt-ampere rated potential transformers connected in parallel. For voltages of 5000 and above nominal rated 200-volt-ampere Westinghouse potential transformers have sufficient inherent capacity to handle the regulator load.

High tension fuse blocks (with resistances where system requirements indicate that they are needed) are recommended for the primary side of the transformer. This is necessary in order to isolate the transformer from the bus in case of severe trouble. No secondary fuses should be used.

**Current Transformers** are used when it is desired to compensate for line drop or for parallel operation of regulators. These transformers may be used for operating ammeters in addition to the regulator, but their use with wattmeters is not recommended as the volt-ampere load would introduce errors in the instrument reading.

The compensating winding of a regulator is designed for 4 amperes. This requires that the current transformer used be of suitable ratio to have 4 amperes in the secondary when carrying full-load line current. The proper transformer is found by multiplying the full load current by  $5/4$  and selecting the nearest standard rated transformer.

The line drop compensator winding is also designed for 4 amperes. For three-phase system the compensator is provided with an auto-transformer,

value. When the short is cleared away, a high voltage results, due to the higher exciter voltage and consequent high generator field current, which lasts until the regulator has had time to again become operative.

This condition of excessive voltage can be prevented by means of the **short circuit protective device**, which can be applied to any Westinghouse a-c. regulator. A diagrammatic view of this device is shown in Fig. 10. It consists of an undervoltage relay in combination with a direct-current control element connected in the main-contact circuit of the alternating-current voltage regulator. The contacts of the d-c. element and the relay are connected in parallel, the pair being in series with the main contacts of the regulator. The d-c. element is energized from the exciter bus, and the relay from the potential transformer supplying the a-c. regulator.

A short circuit coming on a system equipped with this protective device immediately causes the main contacts of the regulator to close and the a-c. relay contacts to open, on account of the drop in the a-c. voltage. As soon as the exciter voltage builds up to the point for which the d-c. element is adjusted the contacts of this element begin to operate and to regulate the exciter voltage in the same manner that the regulator contacts normally do, so that the exciter voltage can never rise above the predetermined point, which is usually a little above the no-load excitation value required by the a-c. generators. When the short circuit is relieved, therefore, no ex-

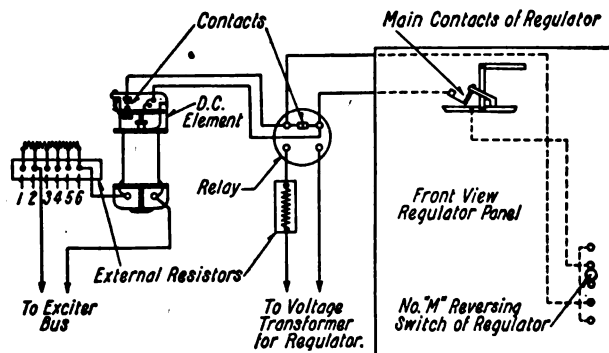


FIG. 10—DIAGRAMMATIC VIEW OF EXCESS VOLTAGE PROTECTIVE DEVICE

mounted inside the case, having a ratio of 7 to 4 amperes. The current transformers should therefore be selected in the same manner as for the regulator compensating winding.

### Short Circuit Protection

With the ordinary type of generator voltage regulator, when a short circuit on a system is cleared away, a dangerous voltage rise is inevitable. On the occurrence of a short circuit on a system without some protective device, the main contacts of the regulator close, causing the relay contacts to close and the exciter voltage to build up to the maximum

cessive field current exists to produce a dangerous rise in a-c. voltage. The moment the a-c. voltage rises above the setting of the undervoltage relay, the contacts of the relay close and put the a-c. voltage regulator back into service.

This protective device is not included in the style number of the regulator, but can be obtained on special order. When ordering, give the type of regulator, voltage of the exciter system, frequency of the a-c. system, the excitation required by a-c. generators to give normal voltage at no-load, and the secondary operating voltage.

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

INSTRUCTIONS FOR ORDERING

Each order or inquiry for quotation must be accompanied by form 1045 for direct-current regulators and form 1046 for alternating-current regulators. Complete information given at the time of ordering prevents unnecessary correspondence and delay in shipment.

Facsimiles of forms 1045 and 1046 are shown on following pages.

A regulating equipment consists of the following parts:

- One regulator.
- One or two condenser sections, for each rheostat shunting relay. The number of condensers per relay depend on the exciter characteristics.
- One condenser section for each master relay that the regulator may have.

One set of brackets (if regulator is for bracket mounting).

One 400-volt-ampere potential transformer with primary fuse blocks and fuses, and on high voltage circuits, with current limiting resistances, where system requirements indicate that they are needed.

Voltage adjusting, exciter, or auxiliary exciter rheostats, as recommended under "Accessories" on a previous page.

If line drop compensation is desired:

- One current transformer for ohmic compensation only.
- Two current transformers with compensator for ohmic and reactance compensation.

PRICES

Alternating-Current Regulators

Prices given are for regulators for 125-volt exciters; regulators for 250-volt exciters will be furnished at same price. Prices for other voltages upon application.

Bracket-Mounted

Style number and list price include regulator, mounted on black marine-finished slate base, 1¼ inches thick. For Blue Vermont Marble for Natural Black Slate base, increase list price \$27.00. For White Italian or Pink Tennessee Marble base, increase list price \$35.00.

Type	Number of Master Relays	SIZE OF BASE		Approx. Shipping Wt., Lbs.	STYLE No. 25 AND 60 CYCLES		List Price
		Width	Height		Range of Excitation 45 to 135 Volts	Range of Excitation 60 to 150 Volts	
<b>For Alternating-Current Generators with 125-Volt Exciters in Parallel</b>							
AB-1	0	16	27 ¼	280	332952	243766	\$1800 00
AB-2	0	16	27 ¼	290	332953	243767	2030 00
AB-3	0	16	27 ¼	300	332954	243768	2390 00
AB-4	1	16	27 ½	305	332955	243769	2705 00
AC-5	1	16	33	320	332956	243770	2915 00
AC-6	1	16	33	325	332957	243771	3090 00
AC-7	1	16	33	330	332958	243772	3250 00
AC-8	1	16	33	335	332959	243773	3450 00
AC-9	1	16	33	340	332960	243774	3505 00
AC-10	1	16	33	345	332961	243775	3620 00
<b>For Alternating-Current Generators with 125-Volt Exciters not in Parallel</b>							
AL-2	0	16	33	305	332962	243864	2100 00
AL-3	0	16	33	310	332963	243865	2490 00
AL-4	1	16	33	315	332964	243866	2825 00
AM-5	1	16	38 ½	320	332965	243867	3190 00

Panel-Mounted

Style number and list price include regulator, mounted on a standard 90-inch black marine-finished slate panel of suitable width, and 2 inches thick. For Blue Vermont Marble or Natural Black Slate panel increase list price \$40.00. For White Italian or Pink Tennessee Marble, increase list price \$50.00. Where purchaser furnishes panel the list price may be reduced \$130.00

Type	Number of Master Relays	DIMENSIONS OF REGULATOR			Approx. Shipping Wt., Lbs.	STYLE No. 25 AND 60 CYCLES		List Price
		Panel Width Inches	Width Inches	Height Inches		Range of Excitation 45 to 135 Volts	Range of Excitation 60 to 150 Volts	
<b>For Alternating-Current Generators with 125-Volt Exciters in Parallel</b>								
AE-1	0	16	16	28	880	371981	243812	\$1700 00
AE-2	0	16	16	28	890	371982	243813	2130 00
AE-3	0	16	16	28	900	371983	243814	2490 00
AE-4	1	16	16	28	905	371984	243815	2805 00
AF-5	1	16	16	33	910	371985	243816	3015 00
AF-6	1	16	16	33	925	371986	243817	3190 00
AF-7	1	16	16	33	930	371987	243818	3350 00
AF-8	1	16	16	33	935	371988	243819	3550 00
AF-9	1	16	16	33	940	371989	243820	3605 00
AF-10	1	16	16	33	945	371990	243821	3720 00
AG-11	2	16	16	50	1050	371991	243822	3900 00
AG-12	2	16	16	50	1055	371992	243823	4015 00
AG-14	2	16	16	50	1060	371993	243824	4715 00
AH-16	2	16	16	60	1065	371994	243825	5020 00
AH-18	2	16	16	60	1070	371995	243826	5300 00
AH-20	2	16	16	60	1075	371996	243827	5555 00
<b>For Alternating-Current Generators with 125-Volt Exciters not in Parallel</b>								
AN-2	0	16	16	33	905	371997	243872	2200 00
AN-3	0	16	16	33	910	371998	243873	2590 00
AN-4	1	16	16	33	915	371999	243874	2925 00
AO-5	1	16	16	38 ½	920	372000	243875	3290 00

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

Direct-Current Regulators

Prices given are for 125-volt and 250-volt regulators. 550-volt regulators will be furnished without change in price.

Bracket-Mounted Regulators for Self-Excited D-C. Generators

Style number and list price include regulator mounted on black marine finished slate base, 1¼ inches thick. For Blue Vermont Marble or Natural Black Slate base, increase the list price \$27.00. For White Italian and Pink Tennessee Marble base, increase list price \$35.00.

Type	Number of Master Relays	SIZE OF BASE		Approximate Shipping Weight, Lbs.	STYLE No.		List Price
		Width Inches	Height Inches		125-Volt	250-Volt	
DA-1	0	8¾	15¼	140	243876	243886	\$985 00
DB-2	0	12½	25	150	243877	243887	1375 00
DB-3	0	12½	25	155	243878	243888	1560 00
DB-4	0	12½	25	160	243879	243889	1665 00
DB-5	0	12½	25	165	243880	243890	1790 00
DB-6	0	12½	25	170	243881	243891	1905 00
DB-7	0	12½	25	175	243882	243892	2035 00
DB-8	0	12½	25	180	243883	243893	2190 00
DB-9	0	12½	25	190	243884	243894	2225 00
DB-10	0	12½	25	200	243885	243895	2355 00

Prices for panel-mounted direct-current regulators type DC-1 and DD-2 to DD-10 are \$100.00 higher than above list prices.

Regulators for Separately-Excited D-C. Generators

Type	Mounting	DIMENSIONS OF REGULATOR		Approximate Shipping Weight, Lbs.	STYLE No.		List Price
		Width Inches	Height Inches		125-Volt	250-Volt	
DK-1	Bracket	16	27¾	210	243916	243918	\$1545 00
DN-1	Panel	16	28	810	243917	243919	1645 00

The direct-current regulators listed above do not include provision for line-drop compensation, but this feature can be supplied upon special order.

Pedestal-Mounted Regulators

All alternating-current and direct-current regulators listed in this section can be furnished mounted on a suitable pedestal at an increase in list price of \$500.00 over list price of panel-mounted regulator.

Accessories

Short-Circuit Protective Device

Description	Style No.	List Price
For 125-Volt Exciters	289655	\$750 00
For 250-Volt Exciters	289656	750 00

Style number includes necessary resistor.

Condensers

Description	Style No.	Each	List Price
Condenser section, one micro-farad capacity.	276225		\$37 50
Frame Mounting for condensers, two required per set of condensers.	257236	Per set of two	5 00

Approximate shipping weight of each condenser section, 5 pounds.

Line Drop Compensators

For Reactance Compensation

SINGLE-PHASE OR TWO-PHASE SYSTEM Percent of Compensation	Style No.	List Price	THREE-PHASE SYSTEM		List Price
			Percent of Compensation	Style No.	
25 Cycles					
12	272361	\$220 00	12	272363	\$255 00
18	272365	225 00	18	272367	260 00
24	272369	230 00	24	272371	265 00
60 Cycles					
12	272362	195 00	12	272364	205 00
18	272366	200 00	18	272368	210 00
24	272370	205 00	24	272372	215 00

A-C. Voltage Adjusting Rheostat

Description	Style No.	List Price
Range of adjustment of secondary voltage, 8¼ volts either way from normal.	313998	\$50 00
Tripod rheostat support for back of board mounting.	312800	36 50

Auxiliary Exciter Rheostat

Auxiliary exciter rheostats when required will be special in most cases on account of the varying requirements.

Order by Style Number

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

400-Volt-Ampere Voltage Transformers

Primary Volts at 100 Volts Secondary	Cycles	Style No.	List Price	Fuse Blocks and Fuses Required For Use With Each Potential Transformer*	Style No.	Current Limiting Resistance Style No.†
200	60	273155	\$110 00	{ 1-2 P. Fuse Block 2-Enclosed Fuses	{ 56359 37153	267034
400	60	273156	115 00	{ 1-2 P. Fuse Block 2-Enclosed Fuses	{ 56359 37185	267034
2000	60	273157	165 00	{ 1-2 P. Fuse Block 2-Enclosed Fuses	{ 117375 32304	267035
2000	25	273158	210 00	{ 1-2 P. Fuse Block 2-Enclosed Fuses	{ 117375 32304	267035

Brackets

For Supporting A-C. Regulators at Either End of Switchboard

Two brackets required per regulator.

Type of Regulator	Type of Frame	Style No.	List Price Per Set of Two
AB, AC, AL, and AM	Angle iron	*214514	\$15 50
AB, AC, AL, and AM	Pipe	*214518	15 50

Approximate shipping weight of one set of brackets, 15 pounds.

For Supporting D.C. Regulators at Either End of Switchboard

Two brackets required per regulator.

Type of Regulator	Type of Frame	Style No.	List Price Per Set of Two
DA	Angle iron	*214515	\$15 50
DA	Pipe	*214518	15 50
DB	Angle iron	*214516	15 50
DB	Pipe	*214520	15 50
DK	Angle iron	*214514	15 50
DK	Pipe	*214518	15 50

Approximate shipping weight of one set of brackets, 15 pounds.

Spare Parts

Description	Style No.	List Price Per Set
Main contacts for alternating-current regulators.	249093	\$44 00
Contacts for rheostat-shunting relays for alternating-current regulators.	205317	7 50
Contacts for vibrating and master relays.	205318	38 75
Main contacts for direct-current regulators, types DA, DB, DC, and DD.	219341	44 00
Main contacts for direct-current regulators, DK and DN.	249093	44 00
Contacts for rheostat-shunting relays for direct-current regulators.	205317	7 50
Pivots and bearings for relays.	280541	7 50

\*Style No. covers one only, two required.  
†For prices, refer to Catalogue Section 1-B.

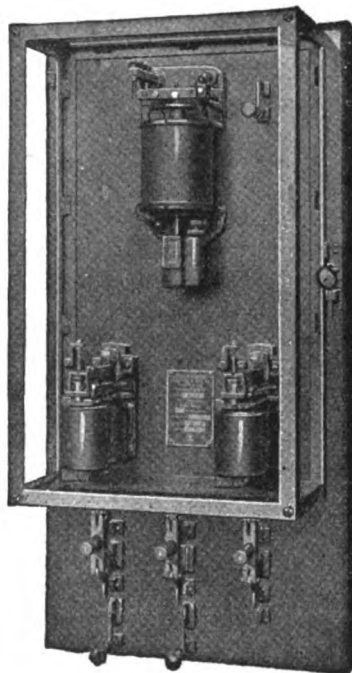


FIG. 11—TYPE DB-2 GENERATOR VOLTAGE REGULATOR

Order by Style Number

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

## RHEOSTATIC-TYPE VOLTAGE REGULATORS

## Application

The rheostatic regulator for alternating current has the same application as the vibrating regulator. The principal applications are.

- (a) Maintenance of constant voltage at bus or generator, or by means of compensators, at some predetermined center of distribution.
- (b) Maintenance of constant voltage by controlling the excitation of synchronous condensers.

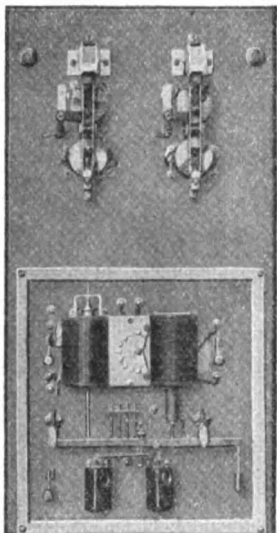


FIG. 12—CONTROL ELEMENT AND MOTOR SWITCHES FOR RHEOSTATIC VOLTAGE REGULATOR

Among the many special applications may be mentioned:

- (a) The control of booster type rotaries.
- (b) The maintenance of constant current instead of constant voltage.

The application of direct-current voltage regulators is limited and should be considered in very special cases only.

## Distinctive Features

The advantages of the rheostatic voltage regulator are:

Operation with regulator is the same as with hand control.

It permits use of a floating storage battery or other reserve direct-current source for excitation. It eliminates the necessity for specially designed exciters.

It is easy to put into or take out of service, thus permitting the operator to quickly and safely change to hand control in an emergency.

The simple and rugged construction employed makes necessary a small amount of attention.

## Operation

The rheostatic type of regulator operates in the same manner as would an attendant regulating the voltage by hand. When the voltage is at the cor-

rect value, the regulator is in equilibrium and there are no parts in motion. Should the voltage deviate, the control element will close one of its two contacts. This completes the circuit to the proper magnet switch, causing its contacts to close the circuit to the rheostat motor, which revolves in the direction necessary to bring the voltage again to normal. When the voltage has reached normal, the motor circuit is broken and the regulator is again in equilibrium. The speed with which voltage variations are adjusted is comparable with that of the vibrating-type of regulator.

The excitation voltage is kept at a constant value. This differs from the vibrating-type of regulator where the exciter voltage varies according to the requirements. A storage battery may be used for reserve excitation as any direct-current source of constant potential is suitable for use with the rheostatic regulator. A drum control switch is provided for placing the regulator in or out of service. Thus, in case of emergency, the generator can be placed on hand control by merely turning this switch.

Line drop compensation is accomplished in the same manner as described under the vibrating-type of regulator.

## Construction

The rheostatic voltage regulator differs from the vibrating-type. It consists of a field rheostat (Fig. 13) operated by a high-speed motor, and a control element together with two magnet switches (Fig. 12), one for either direction of rotation of rheostat. A rheostat of special design is used with this regulator.

The control element is mounted in a suitable case and can be arranged for panel, bracket, or pedestal mounting. It can be adjusted to correspond to the constants of the particular generator with which it is to be used, by means of dash pots mounted below the control coils.

## Prices

Prices will be quoted upon request.

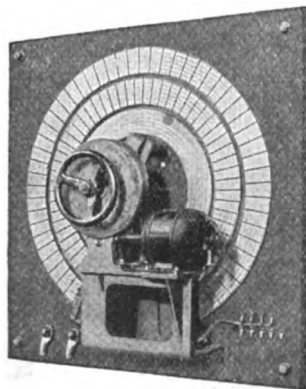


FIG. 13—FACE PLATE OF FIELD RHEOSTAT OPERATED BY HIGH-SPEED MOTOR

## INSTRUCTIONS FOR ORDERING

Each inquiry for quotation must be accompanied by page 2 of form 1046 for alternating-current regulators.

2-405A



## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

## AUTOMATIC CURRENT REGULATORS

## For Electric Arc Furnaces With Movable Electrodes

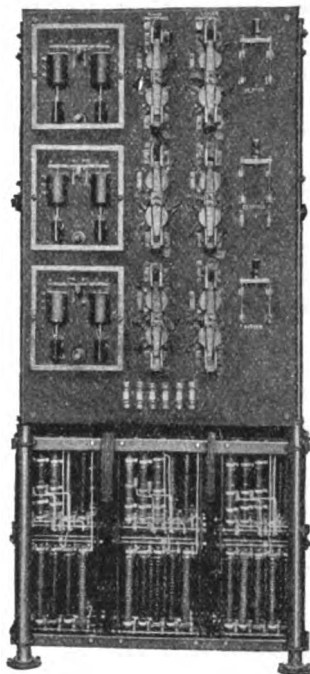


FIG. 1—REGULATOR PANEL

The Westinghouse Regulator, as placed on the market, may be adapted to any furnace melting an electrically conducting charge and having any number of movable electrodes. However, as most furnaces are of either the single-phase or three-phase type, standard designs have been made for these two types only. The Westinghouse Electric & Manufacturing Company can, however, supply regulating equipment for any furnace utilizing movable electrodes.

**Equipment**—The Regulating Equipment consists of two parts, known as the Control Panel and the Regulator Panel. Where the Regulating Equipment only is supplied, the Control Panel is furnished mounted separately on pipe frame. This control panel for a three-phase regulator consists of a slate panel 25 inches by 24 inches mounted on pipe framework which is 65 inches high. The panel has mounted on it three (3) drum control switches for hand control of the electrodes, three (3) rheostats for regulator current element control, three (3) voltage indicating lamps, and a remote-control knife switch for the direct-current power control. There are no exposed live parts on the front of the board, see Fig. 3.

Where a switchboard is supplied with the Regulator, the control apparatus is a part of the switchboard and a separately mounted Control Panel is not required. Fig. 1 shows a view of the regulator panel and Fig. 2 shows the control panel incorporated in an instrument panel.

The Regulator Panel contains the control element, the magnetically operated switches which control the electrode motors, and the necessary resistances, switches and fuses, etc. A small rheostat is mounted on the back of the panel for each electrode which the regulator is to control, and is connected in the voltage-coil circuit. Its purpose is to limit the maximum current for which the rheostat on the control panel can be set. It also provides a means of balancing the current in each electrode for similar settings of the rheostat on the Control Panel.

**Speed of Regulation**—The Regulator is particularly rapid since an electrode speed of  $2\frac{1}{2}$  to 3 feet per minute is possible under automatic control. This high speed aids in maintaining very close regulation. The furnace with a cold charge of steel can be placed under automatic regulation with the rheostats set at full power, and at the end of eight to ten minutes, a sufficient pool of steel will have been formed to give stable electrical conditions.

The freedom from attention to the regulation of the furnace by the melting crew allows them to give their entire attention to the metallurgical aspect of melting, which may result in reducing the number in the crew, particularly if several furnaces are charged and tapped in rotation.

Current surges are brought back to normal with a promptness which results in a reduction in the demand load, especially when a short demand period is the practice of the power company.

The speed with which settled conditions are attained reduces the over-all time per charge and permits a greater production of steel per hour. For small variations in current, the speed is sufficiently slow to prevent continuous breaking of the arc and at the same time, when the solid metal begins to cave into the pools of molten steel under the electrodes, sufficient speed is available to permit the regulator to extricate the electrodes before the overload



FIG. 2—SWITCHBOARD WITH CONTROL EQUIPMENT

relays allow the breaker to trip with the overload surge of current.

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

The ability of the regulator to include high speed with a narrow current zone is due to the fact that the electrode speed is not constant throughout the period of functioning of the regulator, but tapers from full speed to zero as the regulated current approaches its normal value.

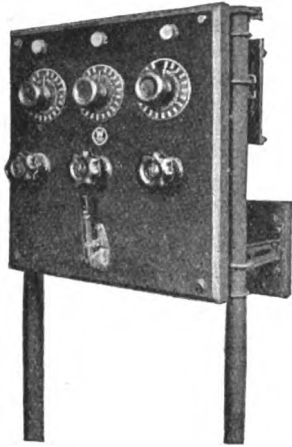


FIG. 3—SMALL CONTROL PANEL

**Voltage Coil Feature**—One very important feature of the Westinghouse regulator is its utilization of the arc voltage as well as the arc current for controlling the electrode motors. This device absolutely prevents the electrodes from getting into the steel under automatic regulation.

On two electrode single-phase, or on two-phase furnaces, a purely current-actuated device will not assure balanced voltages across each arc. In fact, one electrode may be submerged in the steel and the entire regulation may be accomplished by the other electrode. The voltage control compels balanced voltages across the arc, as well as balanced phase currents.

Another good feature of the voltage coil on the control is that it makes the control of each electrode independent of the others in the furnace. In fact, one electrode may be entirely withdrawn without disturbing any of the others, whereas in a regulator depending exclusively on current for its control, any movement of one of the electrodes causes a displacement of all of the others in the furnace.

**Acid Lining**—Since the voltage between the bath and each electrode is utilized, it is necessary, therefore, to obtain in some way electrical contact between the furnace shell and the liquid steel. In a basically lined furnace, the conductivity of the lining is sufficient and no further conducting means are required. With an acid lining, however, the lining when cold is non-conducting and until this type of lining has been heated, it is necessary to make provision of some kind to get contact between the bath and outside furnace shell. A simple method for doing this is by inserting a scrap steel bar through the furnace door into the charge, allowing the door to close tightly down on it.

This gives sufficient contact until the lining has been heated, when its conductivity will be sufficient for operation of the voltage coil.

**Distinctive Features of Westinghouse Regulator:**

Anti-hunting. The regulator will not hunt.

Electrodes, with automatic regulation, cannot get into the steel under any circumstances.

Full automatic regulation during entire heat.

Reduced time to melt-down, due to higher speed of regulation. Tests have established this.

Greater tonnage, because the regulator needs absolutely no attention from operators.

Application of full torque to motors at all times. The motors never refuse to start.

Simple, rugged, magnetic-switch group. Two switches per electrode, stop, start, and reverse the motor; also, they apply dynamic braking.

High electrode speed on both the hand and automatic operation.

Small hand controllers, convenient for the operator. All three electrodes can be operated at the same time.

Each electrode is independent of all others, and one may be placed on hand control while the others are placed on the automatic, if so desired.

High precision of regulation.

Pilot lights are furnished to indicate arc voltages.

The regulator prevents electrode breakage.

No under-voltage relays; this simplifies the layout considerably.

No arcing at main contacts of the regulator; these contacts will last indefinitely.

No coil burnouts on low power.

No mechanical or electrical interlocks.

**Styles**—In the majority of cases where regulators are desired, the Company will be asked to furnish the complete switching equipment, which will consist of a Regulator Panel as shown in Fig. 1, a Control and Instrument Panel combined as shown in Fig. 2, and a separate small panel for the control of the d-c. end of a motor-generator set when required. Since in such cases, the equipment is extremely variable no standard style number has been given to the equipment. Such cases should be referred to the Company for specifications and price. However, for cases where only the Westinghouse Electric and Manufacturing Company Regulator is required for use with existing installations or with switchboards of other manufacture, style numbers have been assigned. For single-phase and two-phase equipment, refer to the Company. Current transformers must be ordered separately.

Style No.	Description	Wt. Lbs.	List Price
300431	Consists of the Three-phase Regulator as shown in Fig. 1.	1200	\$3800 00
296615	Consists of the Control Panel as described under equipment above and shown in Fig. 3.	500	1100 00

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

Form 1046-G  
(2 Sheets) Sheet 1

**Westinghouse Electric & Manufacturing Company**  
East Pittsburgh, Pa.

.....  
(Purchaser's Name)

Station..... Negotiation No. .... Date.....19..

**DATA SHEET FOR VOLTAGE REGULATORS FOR ALTERNATING-CURRENT GENERATORS**  
or for separately excited D-C. generators

In order to secure correct regulator application, it is desirable that complete data, as requested below, be given.

**EXCITER INFORMATION:**

Exciter	No. 1	No. 2	No. 3	No. 4	No. 5
1. Kw. capacity.....					
2. Rated voltage.....					
3. Rated speed.....					
4. Number of poles.....					
5. Serial No.....					
6. Type.....					
7. Manufacturer's name.....					
8. Shunt or compound-wound.....					
9. Interpole or non-interpole.....					
10. Laminated or solid main field poles..					
11. Exciter shunt field current at no load and rated voltage.....					
12. Exciter shunt field current and armature volts at no load, 10 per cent above rated voltage.....	} Amps.				
		} Volts			
13. Exciter shunt field current and armature volts at no load and full field (rheostat all out).....	} Amps.				
		} Volts			
14. Give name plate reading of rheostat.....	} Amps.				
		} Ohms			
			} No. of Steps		
In what time will the shunt field rheostat lower the voltage from normal to 1/2 normal with generator field load on exciter.....					
Note—For complete information see reverse side of this sheet					
15. How are exciters driven?.....					
16. Speed regulation of prime mover; if water wheels do they have automatic governors?.....					

17. Is regulator to be suitable for single operation or parallel operation of exciters? .....

NOTE—Unless paralleling the exciters is required by station operating conditions, Westinghouse voltage regulators can be supplied suitable for single operation of exciters with parallel operation of generators.

GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

Form 1046-H  
(6 Sheets) Sheet 2

A-C. GENERATOR, SYNCHRONOUS CONDENSER OR SYNCHRONOUS MOTOR INFORMATION:

A-C. Generators in Parallel	No. 1	No. 2	No. 3	No. 4	No. 5
18. Kva. capacity .....					
19. Rated Voltage .....					
20. Normal operating voltage at no load .....					
21. Operating voltage at maximum load .....					
22. Rated speed .....					
23. Manufacturer's name .....					
24. Serial number .....					
25. Voltage directly across field at no load and normal operating voltage .....					
26. Voltage drop directly across field under maximum operating conditions. (Give Kva. load).....					
26A. For syn. cond. only, give voltage drop across field under max. lagging zero per cent P. F. conditions					
27. How are generators driven? .....					
28. Speed regulation of prime movers.....					

29. Is system single phase, two phase or three phase? ..... Frequency in cycles per second....
30. Is compensation for line drop desired? ..... If so the following information is required to enable us to make proper recommendations:
- (a) Single line diagram of system. Indicate the feeders for which compensation is desired, together with their wire size, spacing, voltage, and distance to the load center.
  - (b) Maximum current in feeder for which compensation is desired.....
  - (c) Maximum variations in feeder power factor .....
31. Indicate nature of load, giving percentage of each:—Lighting.....%. Motor.....%, Elevator Motor.....%. Note character of any load causing serious voltage fluctuations.

REGULATOR INFORMATION

32. General finish of metal parts on switchboard.....Standard is dull black.
33. Material and finish of regulator base.....Standard is black marine finished slate.
34. If regulator is to be bracket mounted state whether switchboard framework is angle iron or pipe...
35. If regulator is panel mounted, state height of each section.....; thickness.....; bevel.....; type of switchboard frame.....; and distance from top of panel to top of regulator..... (If not specified this dimension will be in accordance with our standard practice.)

Additional Information .....

.....

Signed .....

## GENERATOR VOLTAGE AND ARC FURNACE REGULATORS—Continued

**TIME CONSTANTS OF EXCITERS**

## Explanation of question No. 14

The quality of regulation depends largely on the response of the exciter to the regulator. It is, therefore, important to know the time constants of the exciters and to make the necessary alterations if these are unsatisfactory, to secure the best results.

The time constants of an exciter should be taken under load. The load used should be the field or fields of the a-c. generators it is intended to supply.

If the plant is in continuous service, the test can be most conveniently made by running temporary leads directly from the exciter main switch to the generator field switch. The leads can be run either in front or rear of the switchboard. The exciter and generator field switches must be left open during the test to keep clear of the rest of the system. Care should be taken to see that the field discharge resistance is out of circuit during the test as it may become overheated.

If the plant is not in continuous service, or if an extra set of bus-bars is available, the exciter and generator switches may be closed as when operating.

**GENERATOR:**

The a-c. generator rheostat should be set so that when running at normal speed 60 volts on the exciter gives normal voltage on the generator at no load, if 125-volt exciters are used. Proportional values should be taken for other exciter voltages.

The a-c. generator is preferably shut down during the test. If this cannot be done, care should be taken not to allow the generator to carry excessive voltages except momentarily. If the a-c. voltage is above 6600, the generator rheostats should be set so that with 125 volts on the exciter the a-c. voltage does not rise more than 25 per cent above normal.

**EXCITER:**

A single-pole switch should be connected across the exciter rheostat so that when the switch is closed, the rheostat is short-circuited. The rheostat should be entirely cut in. The switch should be located convenient to the exciter voltmeter.

With all connections made, the switch should be closed and the time taken for the exciter to build up from 30 to 125 volts. The switch should be opened at 125 volts, and the time taken for the exciter to fall from 125 to 30 volts.

These measurements of time should be made with a stop watch. If this is not available, the second hand of an ordinary watch may be used, but the results are not accurate and two persons are necessary to make the test.

The time to build up or down should be 4 seconds or less for the best results.

Fac-Simile of Data Sheet, Form 1046, Reverse Side of Sheet 1

**Westinghouse Electric & Manufacturing Company**  
Works, East Pittsburgh, Pa.

.....  
(Purchaser's Name)  
Station..... Negotiation No..... Date.....192....

**DATA SHEET FOR VOLTAGE REGULATORS FOR SELF-EXCITED DIRECT-CURRENT GENERATORS**

For separately-excited D-C. Generators, Data Sheet for A-C. Generators, Form 1046-D should be used.  
In order to insure correct regulator application it is desirable that complete data, as requested below, be given, and that particular attention be given question 20.

**GENERATOR INFORMATION:**

Generators in Parallel .....	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6
1. Kw. capacity .....	.....	.....	.....	.....	.....	.....
2. Rated voltage .....	.....	.....	.....	.....	.....	.....
3. Rated speed .....	.....	.....	.....	.....	.....	.....
4. Number of poles .....	.....	.....	.....	.....	.....	.....
5. Serial No.....	.....	.....	.....	.....	.....	.....
6. Type .....	.....	.....	.....	.....	.....	.....
7. Manufacturer's name .....	.....	.....	.....	.....	.....	.....
8. Shunt or compound .....	.....	.....	.....	.....	.....	.....
9. Interpole or non-interpole .....	.....	.....	.....	.....	.....	.....
10. Laminated or solid main field poles .....	.....	.....	.....	.....	.....	.....
11. Shunt field current at no load and rated voltage .....	.....	.....	.....	.....	.....	.....
12. Shunt field current at no load and full-field. (Rheostat all out) .....	.....	.....	.....	.....	.....	.....
13. Armature volts at no load and full field. (Rheostat all out) .....	.....	.....	.....	.....	.....	.....
14. State resistance of field rheostat .....	.....	.....	.....	.....	.....	.....

Reduced Fac-Simile of Data Sheet, Form 1045, Sheet 1

- 15. How are generators driven? .....
- 16. Speed regulation of prime movers .....
- 17. Are pressure wires brought back from center of distribution? .....
- If not, is compensation for line drop desired? .....
- 18. State percentage of line drop in circuit for which compensation is desired .....
- 19. State current in circuit for which compensation is desired .....
- 20. Indicate nature of load, giving percentage of each:
  - Lighting .....
  - Motor .....
  - Elevator .....
  - Miscellaneous .....

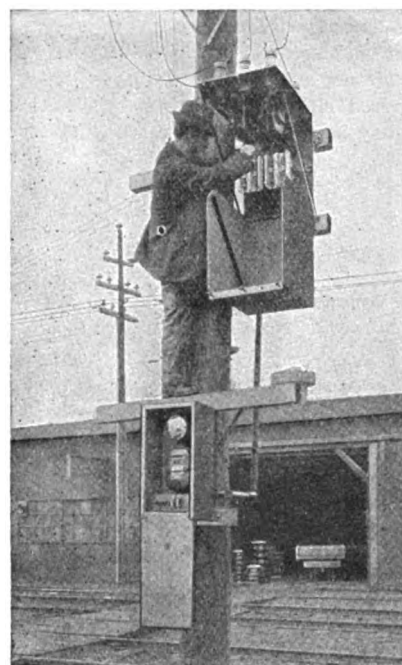
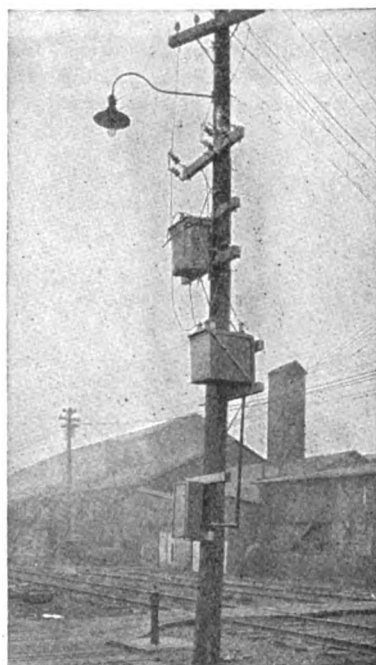
**REGULATOR INFORMATION:**

- 21. General finish of metal parts on switchboard .....
- Standard is dull black.
- 22. Material and finish of regulator base .....
- Standard is black marine finished slate.
- 23. If regulator is bracket mounted, state whether switchboard frame work is angle iron or pipe .....
- 24. If regulator is panel mounted, state height, thickness, bevel and number of sections of panel, and type of switchboard frame .....
- Additional information .....

Reduced Fac-Simile of Data Sheet, Form 1045, Sheet 2

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS

### TYPE N METERING EQUIPMENTS



#### Application

The type N metering equipments have been designed for those feeder installations where metering is the only requirement or where an air break disconnecting switch is being used. The equipment is pole mounted, and consists of an accessible housing for the high tension connections and instrument transformers, to be located near the top of the pole, together with a meter cabinet located at a convenient height above the ground for meter reading.

**Capacity**—These metering equipments have been developed for single and three-phase, 25 and 60-cycle service, with current ratings not exceeding 750 amperes, and for voltages not exceeding 6600. (For outdoor metering equipments for high voltages, see Section 3-B of this catalogue).

#### Construction

The general construction and arrangement of the instrument transformer housing and meter cabinet may be seen from the above illustrations. The transformer housing is of heavy gauge sheet steel. The fixed member, comprising the back and top, is so formed as to give ample strength with the use of a minimum amount of material. Economy in cost and weight is thereby obtained. The hinged cover forms the other four sides of the housing, and when lowered, readily makes accessible all apparatus.

All joints in the fixed part and cover of the housing are welded to assure weather tightness. Further assurance against weather conditions is obtained by having the edges of the fixed part overlap the cover when closed. The cover when closed is held in place by brass thumb screws, and is provided with means for padlocking.

The meter cabinet is also of welded steel construction, having a sliding cover which lowers against a stop. Means are provided for padlocking the cover. The secondary metering leads are brought to the cabinet through standard conduit, and fittings, which are furnished by the purchaser. Either the type OA watt-hour meter or the type RH thermal demand watt-hour meter can be located in the cabinet and have ample space about it. For testing and calibrating the instrument, testing terminals are included.

The construction enables a lineman mounting the pole on climbers to exchange potential fuses or to remove or to install instrument transformers without difficulty.

**Finish**—Both housing and cabinet are finished inside and out with a high grade weather-proof paint, battleship grey in color.

**Wiring and Erection**—The equipments are shipped completely wired, ready for the purchaser to make the external connections to the high tension

OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

terminals and to install the secondary wiring between the housing and the cabinet. The housing is easily installed although it is customarily placed at a greater height than shown in the illustration.

List price includes the two weather-proof housings (one for instrument transformers and one for watt-hour meter), and standard metering equipment, with leads ready to connect to the power circuit. Conduit and secondary wiring between the two houses are not included.

If desired, either a type RO or type RA demand meter may be substituted in place of the type OA

watthour meter included in the standard equipment. For this substitution add to the net price, the difference between the net prices of the demand and watthour meters.

Intermediate capacities will be furnished at the price of the next higher capacity listed. Other capacities for single-phase and polyphase service and various combinations of meters can be supplied on special order, prices upon application. In ordering always give complete data, including frequency, voltage, and maximum current capacity of circuit controlled.

TYPE N METERING EQUIPMENT

POLE MOUNTING

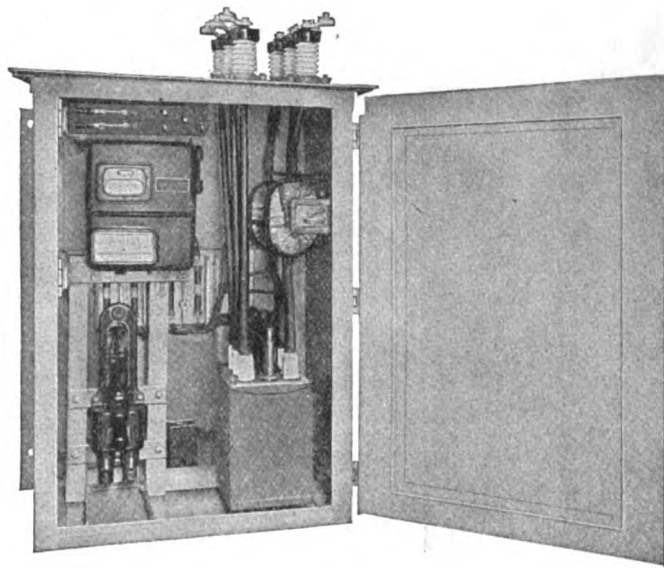
Volts	Amperes	TRANSFORMER BOX			METER BOX			Approx. Shipping Wt., Lbs.	LIST PRICE	
		Height Inches	Depth Inches	Width Inches	Height Inches	Depth Inches	Width Inches		60-Cycle	25-Cycle
<b>Single-Phase</b>										
2500	100	33	28	21	34	10	14	420	\$255 00	\$276 00
2500	300	33	28	21	34	10	14	430	280 00	281 00
2500	500	33	28	21	34	10	14	445	265 00	286 00
6600	100	33	28	21	34	10	14	620	395 00	410 00
6600	300	33	28	21	34	10	14	625	400 00	415 00
6600	500	33	28	21	34	10	14	630	405 00	420 00
6600	750	33	28	21	34	10	14	640	410 00	425 00
<b>Three-Phase</b>										
2500	100	33	28	21	34	10	14	365	345 00	358 00
2500	300	33	28	21	34	10	14	370	350 00	363 00
2500	500	33	28	21	34	10	14	375	355 00	368 00
2500	750	33	28	21	34	10	14	395	360 00	373 00
4500*	100	33	28	25	34	10	14	425	386 00	392 00
4500*	300	33	28	25	34	10	14	435	391 00	397 00
4500*	500	33	28	25	34	10	14	450	396 00	402 00
4500*	750	33	28	25	34	10	14	460	401 00	407 00
6600	100	33	28	25	34	10	14	735	534 00	576 00
6600	300	33	28	25	34	10	14	745	539 00	581 00
6600	500	33	28	25	34	10	14	760	544 00	586 00
6600	750	33	28	25	34	10	14	770	549 00	591 00

\*For 3-phase, 4-wire grounded neutral circuits.



## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

## TYPES I, F AND G SWITCH-HOUSES



TYPE I SWITCH-HOUSE

**Application**

The types I, F and G switch-houses include both **circuit-breaker and watthour meter equipments** properly housed and protected for mounting in exposed locations. They are used for the control of outdoor distributing substations which supply power to small towns, farming communities, manufacturing plants, mines, quarries and numerous similar installations where the connected load is not large enough to warrant the expense of a substation building with indoor apparatus. The service switch provided is suitable for a medium-capacity station.

**Capacity**—These equipments are listed single-phase and three-phase, in capacities up to 600 amperes at 7500 volts or 800 amperes at 2500 volts. The scope of each particular type of house with limiting standard ratings is given in the tables.

Equipments for three-phase service in capacities other than those listed and for two-phase service, as well as for various combinations of meters, will be furnished on special order.

**Construction**

The weather-proof house, in which the equipment is enclosed, is built of heavy-gauge sheet steel over a substantial structural steel supporting frame.

The arrangement of the apparatus and the incoming and outgoing leads is such as to allow ready accessibility without danger of accidental contact with the high tension conductors.

The type I houses are suitable for pole, wall, or tower mounting, provision being made for hanger irons so that they can be mounted in the same manner as distributing transformers.

In addition to the main door at the front of the house, there is a hinged door on the bottom which swings down and allows the easy removal of the circuit-breaker tank for the inspection or adjustment of contacts. Further accessibility is provided by mounting the instrument on a hinged panel which swings forward exposing the instrument transformers and particularly the potential transformer fuses. The door is provided with a hasp for padlocking.

The type F switch-house is a design paralleling the type I house in current and voltage ratings. It is applicable where a less expensive equipment than the type G is wanted for ground mounting to control a relatively small capacity. It is smaller in size but of the same general construction as the type G house.

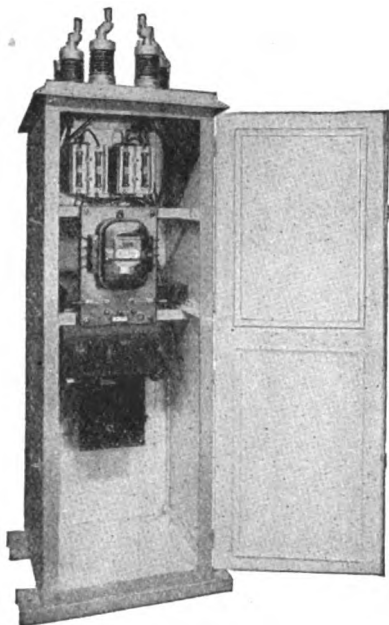
Access to the apparatus is gained through large hinged doors at both front and rear of the house. The doors are provided with hasps for padlocking.

The type G switch-house is designed to stand on its own base, and is of sufficient height to prevent accidental contact with the incoming and outgoing leads.

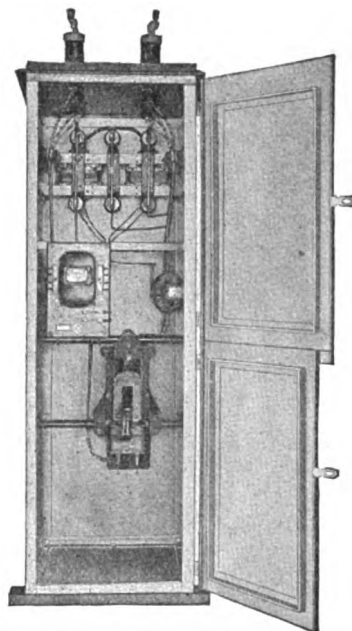
As in the type F house, access to the apparatus is gained through large hinged doors at both front and rear of the house. Hasps are provided for padlocking.

**Finish**—The inside and outside of the switch-house are finished with the best quality weather-proof paint.

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued



TYPE F SWITCH-HOUSE



TYPE G SWITCH-HOUSE

The color of this paint is a "battleship grey," which harmonizes with the standard finish on large outdoor power transformers, electrolytic arresters, and oil circuit-breakers. The finish of all details mounted within the house is dull black.

**Apparatus**—The standard **three-phase equipment** consists of:

One oil circuit-breaker, three-pole, single-throw, full-automatic.

One watt-hour meter, type OA, polyphase.  
Two current transformers\* of suitable ratio.

For equipments above 440 volts, two voltage transformers with primary fuse blocks and fuses.

One set of calibrating and testing terminals.  
All necessary wiring.

The standard **single-phase equipment** consists of:

One oil circuit-breaker, two-pole, single-throw, full-automatic.

One watt-hour meter type OA single-phase.  
One current transformer of suitable ratio.

For equipments above 440 volts, one voltage transformer with primary fuse block and fuses.

One set of calibrating and testing terminals.  
All necessary wiring.

The types I and F houses are applicable for circuits of 400 amperes and below. They are equipped with the type F-11 wall-mounting remote-controlled oil breaker having full-automatic transformer-trip either with or without the inverse-time-limit feature.

The type G design is applicable for circuits within the ratings of the types F-22, and BA circuit-breakers, the breaker furnished depending upon the requirements. These breakers are panel-mounted, full-automatic transformer-trip with or without the inverse-time-limit feature.

All of the circuit-breakers mentioned above are described in more detail in another section of this catalogue.

A standard type OA watt-hour meter is furnished mounted on a slate panel together with calibrating and testing terminals. The voltage terminals are of the binding-post type and the current terminals of the knife-switch type. The latter permits the connecting and inserting of the current coils of the test meter in series with the current coils of the service meter without interruption of service to the customer or danger to the meterman.

**Wiring and Connections**—All wire is of National Electrical Code standard, insulated to provide a high factor of safety. All studs and live parts are thoroughly insulated and taped. The switch-house is shipped completely wired and assembled, including inlet and outlet bushings, so that it is only necessary to connect it to the lines and to put the oil in the switch tanks.

**List price** includes the weatherproof switch-house and standard switching and metering equipment with the necessary wiring ready to connect to the power circuit.

\*One additional current transformer is included for 3-phase 4-wire grounded neutral equipments.

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

If desired, either a type RO or type RA demand meter may be substituted in place of the type OA watt-hour meter included in the standard equipment. For this substitution add to the net price, the difference between the net prices of the demand and watt-hour meters.

Intermediate capacities will be furnished at the

price of the next higher capacity listed. Other single and three-phase capacities, all two-phase capacities, and various combinations of meters can be supplied on special order, prices upon application. In ordering always give complete data, including frequency, voltage, and maximum current capacity of circuit controlled.

## STANDARD OUTDOOR SWITCH-HOUSES

Volts	Amperes	Approx. Height Inches	Approx. Depth Inches	Approx. Width Inches	Approx. Net Wt. Lb.	LIST PRICE	
						60-Cycle	25-Cycle
<b>TYPE I (POLE MOUNTING)</b>							
<b>Single-Phase</b>							
2500	100	50	21	30	600	\$452 00	\$456 00
2500	200	50	21	30	695	467 00	461 00
<b>Three-Phase</b>							
2500	200	50	21	30	655	600 00	453 00
2500	400	50	21	30	755	606 00	458 00
4500*	200	50	21	30	790	679 00	685 00
4500*	400	50	21	30	800	684 00	690 00
<b>TYPE F (GROUND MOUNTING)</b>							
<b>Single-Phase</b>							
2500	200	72	24	30	725	415 00	430 00
2500	400	72	24	30	775	448 00	478 00
<b>Three-Phase</b>							
2500	200	72	24	24	775	585 00	605 00
2500	400	72	24	24	825	610 00	630 00
4500*	200	72	24	24	860	635 00	650 00
4500*	400	72	24	24	900	655 00	690 00
<b>TYPE G (GROUND MOUNTING)</b>							
<b>Single-Phase</b>							
7500	300	72	36	30	935	815 00	830 00
<b>Three-Phase</b>							
2500	400	72	36	30	935	625 00	640 00
2500	600	72	36	30	985	683 00	698 00
2500	800	72	36	30	1035	745 00	760 00
4500*	200	72	36	30	1135	655 00	675 00
4500*	400	72	36	30	1185	720 00	720 00
4500*	600	72	36	30	1235	775 00	750 00
7500	400	72	36	30	1300	1070 00	1100 00
7500	600	72	36	30	1305	1090 00	1120 00

\*For 3-phase, 4-wire grounded neutral circuits.

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

## OUTDOOR HOUSES FOR TYPES B, E, AND O-1 OIL CIRCUIT-BREAKERS

**Application**

Switch houses for enclosing types B, E, and O-1 oil circuit-breakers have been provided to take care of situations necessitating the use of heavier capacity breakers than can be accommodated in the types I, F, and G houses. Metering equipment is not included, but overload and control relays are ordinarily furnished, and are mounted on a small panel within the switch house. The designs provide what is essentially a factory-built single unit substation, and have proved to be very economical in cost and space requirements for numerous applications.

**Capacity**—Equipments are provided for either single or three-phase service for currents of from 300 to 600 amperes at 15,000 or 25,000 volts. Equipments suitable for handling currents up to 2000 amperes at 25,000 volts can be furnished on special order. Quotations on other special breaker requirements to meet the purchaser's service conditions will be furnished on request.

**Construction**

The houses, thoroughly weatherproof, are carefully constructed of heavy gauge sheet steel over a supporting frame of structural steel. The roof is of a form giving maximum clearance between the live parts of the high voltage roof bushings. Ventilating ducts, weatherproof in their arrangement, run the full length of the houses on either side just under the eaves of the roof. These ducts are screened to pre-

vent the entrance of insects, birds, or vermin. Screened ventilating holes are also provided in the floor so that a good circulation of air is assured, effectively preventing the sweating of the apparatus.

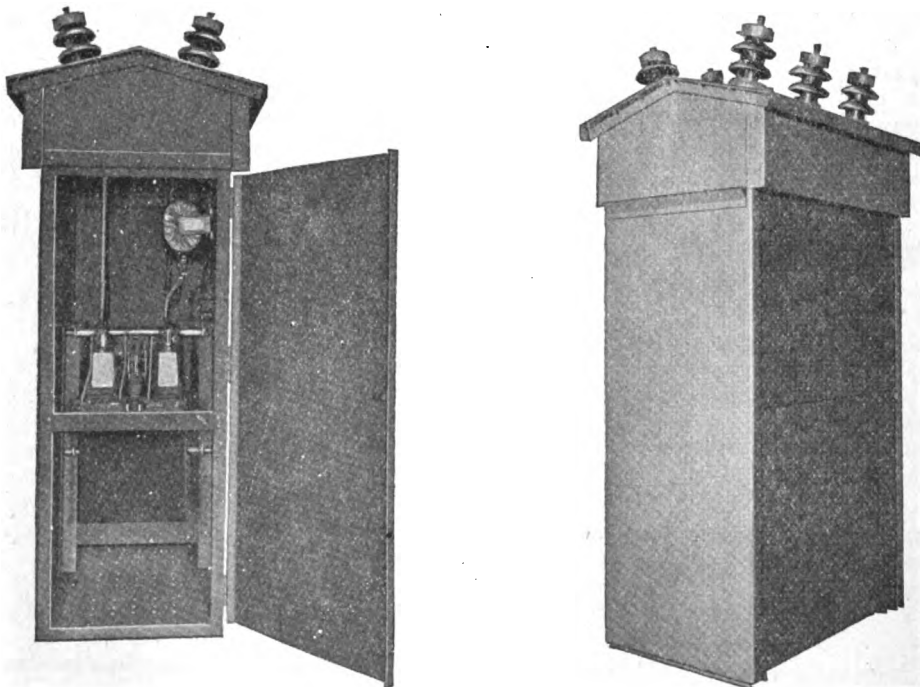
Houses for type B circuit-breakers are furnished with single doors at front and rear. Larger houses for accommodating types E and O-1 breakers have double doors at front and rear. All houses are provided with suitable hasps for padlocking. As will be seen from the illustrations, the arrangement of doors provides unusual accessibility for inspection or adjustment.

**Finish**—The houses are finished inside and out with a durable weather-proof paint, "battleship grey" in color.

**Prices and weights** will be quoted upon request.

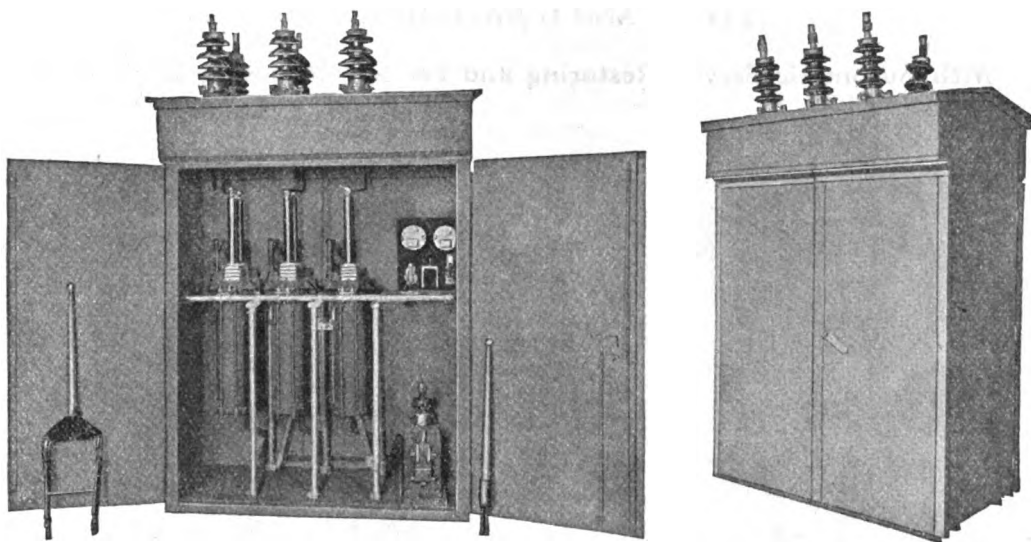
**Breaker Equipments**

The small houses are equipped with the type B-2 or B-13 oil circuit-breakers. Breakers are furnished for either manual or electrical operation, as required. They are pipe-frame mounted, and are rigidly secured and braced to the structural steel frame of the house. Manually-operated breakers are provided with transformer-trip coils, and can be equipped with inverse-time-element attachments or with direct-trip attachments and over-current relays. Electrically-operated breakers are supplied with the usual closing and tripping coils, and over-current and control relays for making the breakers full automatic. The necessary current transformers are included.



SWITCH-HOUSE WITH TYPE B-2 OIL CIRCUIT-BREAKER FOR 15,000-VOLT SERVICE

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued



SWITCH-HOUSE WITH TYPE E-17 OIL CIRCUIT-BREAKER FOR 25000-VOLT SERVICE

Larger houses are equipped with the types E-17 or E-9 oil circuit-breakers, pipe-mounted and electrically-operated. However, manually-operated breakers can be furnished if desired. The over-current and control relay equipment furnished is similar to that described above for the type B breakers. Bushing-type current transformers are furnished.

Houses similar to those accommodating type E breakers except of greater dimensions, are equipped with type O-1 electrically-operated oil circuit-

breakers. The breaker is mounted on a channel-iron frame, rigidly braced, and secured to the house framework and the electrical mechanism is mounted on the floor. A control panel is furnished upon which are mounted the overcurrent and control relays, for making the circuit-breaker full automatic. These relays have the same functions as those furnished for the electrically-operated breakers of the types B and E houses. The necessary current transformers of the bushing-type are included.

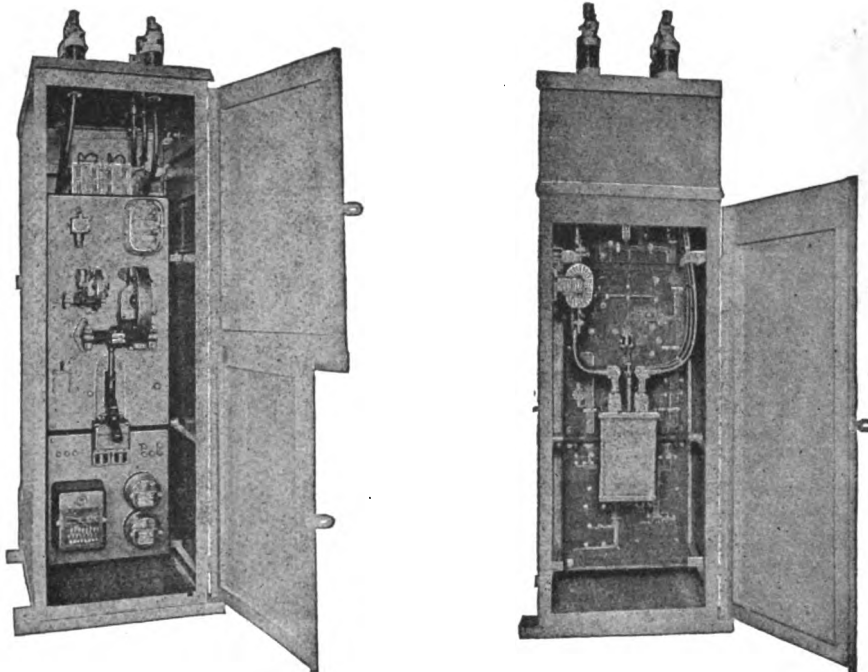
## HOUSES FOR TYPES B, E AND O-1 OIL CIRCUIT-BREAKERS (GROUND MOUNTING)

Volts	Amperes	Approx. Height Inches	Approx. Depth Inches	Approx. Width Inches	LIST PRICE	
					60-Cycle	25-Cycle
<b>FOR TYPES B-2 AND B-13 OIL CIRCUIT-BREAKERS</b>						
<b>Single-Phase</b>						
25000	300	120	40	51	On Request	
<b>Three-Phase</b>						
15000	300	120	40	51	On Request	
15000	600	120	40	51	On Request	
25000	300	120	40	51	On Request	
25000	600	120	40	51	On Request	
<b>FOR TYPES E-17 AND E-9 OIL CIRCUIT-BREAKERS</b>						
<b>Three-Phase</b>						
25000	300	123	36	72	On Request	
25000	600	123	36	72	On Request	
<b>FOR TYPE O-1 OIL CIRCUIT-BREAKERS</b>						
<b>Three-Phase</b>						
25000	600	130	42	92	On Request	

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

## TYPE F AND G SWITCH-HOUSES

## With Automatic Service-Restoring and Periodic-Reclosing Equipment



FRONT AND REAR VIEWS OF TYPE G SWITCH-HOUSE WITH PERIODIC-RECLCING EQUIPMENT

**Application**

Switch houses with automatic service-restoring and periodic-reclosing equipments have been designed to meet the demand for alternating-current outdoor switching stations with automatic features similar to those of the automatic direct-current substation but for alternating-current service. These equipments are suitable for the control of feeders with voltages up to 25,000 volts and currents up to 600 amperes where it would be too expensive to maintain an operator, but where the circuit is of such importance as to require the assurance that service will be maintained except in the more serious cases of trouble.

Any of the switch houses previously mentioned, except the type I can be supplied with this automatic service-restoring or periodic-reclosing breaker equipment.

Service-restoring equipments are for use on feeders supplying a synchronous load. After automatically tripping, the circuit breaker will close immediately. This short time is sufficient to de-energize the circuit and clear away any trouble of a temporary nature, but not sufficient to allow the synchronous apparatus to drop out of step.

When no synchronous load is connected to the circuit, switch houses with the periodic-reclosing equipment are the most suitable. The circuit

breaker, after opening automatically, will reclose, only after a predetermined time interval. The duty imposed upon the circuit breaker with this type of equipment is less severe than with the service-restoring equipment.

Due to the more severe service imposed on the circuit breakers used with these two types of equipment, the interrupting capacity of the breaker will be less than the usual guaranteed ratings which are based on two openings with a two-minute interval between each. After the service conditions are once determined, the interrupting capacity of the breaker can be given.

**Operation**

**Service-Restoring Equipment**—The breaker opens under short circuit or heavy overload in the usual way and is then instantly reclosed. Should the fault still remain, the breaker again opens and the instantaneous reclosing operation is repeated. This cycle is repeated a predetermined number of times; usually a maximum of two, (breaker opens three times). Should the trouble still exist, the apparatus becomes locked with the breaker in the open position. If the trouble is cleared while the apparatus is going through the reclosing cycle, the breaker remains closed and the automatic apparatus returns to its normal position. To place the equip-

## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

ment in operation after locking itself out, the circuit breaker is closed by means of a push button switch.

**Periodic-Reclosing Equipment**—The breaker opens under short circuit or heavy overload in the usual way and, after a certain predetermined time-interval, it is reclosed by the automatic equipment. Should the trouble still exist, the breaker again opens and is again reclosed after the same time interval. When the breaker has opened a certain number of times the control apparatus becomes locked with the breaker in the open position. Should the trouble be cleared before the predetermined number of reclosures has been made, the breaker remains closed and the automatic apparatus returns to its normal position. To place the equipment in service after locking itself out, the breaker is closed by means of a push button switch, after the line has been cleared, and the equipment resets automatically for normal operation.

On the standard equipment, provision is made for three automatic reclosings (circuit breaker opens four times) at intervals of  $\frac{1}{2}$ , 1, or 2 minutes. To change the time interval it is only necessary to change the gears provided with the periodic relay. Relays can be supplied with gears for time intervals of one, two, or four minutes, if desired.

**General**—The limiting relay furnished with the service-restoring equipment and the periodic relay furnished with the periodic-reclosing equipment start to return to the zero position immediately on the reclosing of the circuit breakers. Should the trouble be cleared before these relays have operated to lock out the equipment, they will return to the full zero position. Any subsequent case of trouble will cause the circuit breaker to open the full number of times in case it cannot be cleared by the first, second or third opening.

**Equipment**

**Service-Restoring**—The standard three-phase equipment consists of:

One black marine slate panel having mounted thereon:

- One restoring relay.
- One limiting relay.
- One auxiliary relay.
- One push button switch.
- One "re set" push button.
- One automatic oil circuit-breaker 3 P. S. T. with a-c. operating mechanism.
- Two current transformers.

**Periodic-Reclosing**—The standard three-phase equipment consists of:

One black marine slate panel having mounted thereon:

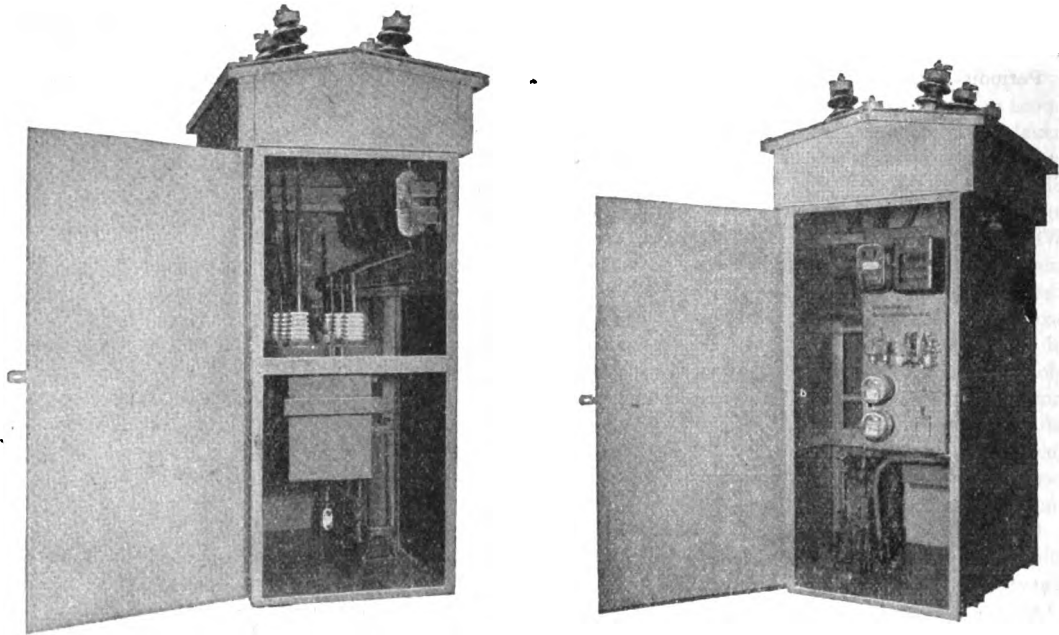
- One set-up relay.
- One circuit breaker control relay.
- One periodic motor relay.
- One "re-set" push button.
- One automatic oil circuit-breaker, 3 P. S. T., with a-c. operating mechanism.
- One push button switch.
- Two current transformers.

**General**—There will be required for mounting external to the switch house, for either of the above: One operating transformer—the size and secondary voltage depending on the type of breaker used. This is usually supplied by the customer in accord with his standard type of distribution transformer.

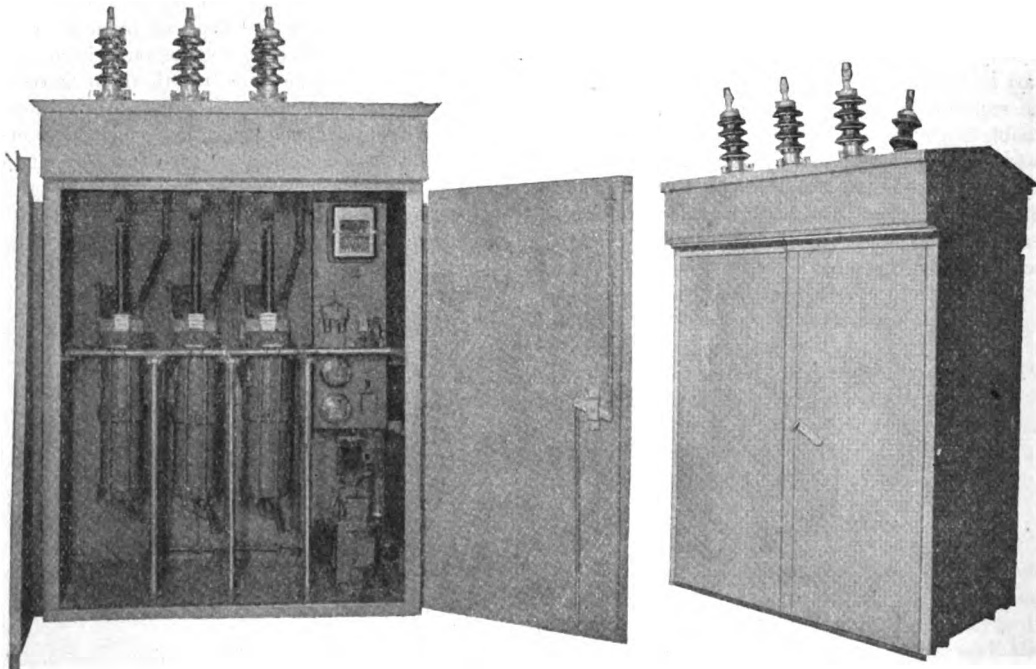
**Instruments**—The standard type OA watt-hour meter (switchboard mounting), and type CO overload relays may be supplied for mounting on a panel in the switch house, or for mounting on a switchboard, indoors. These meters and relays are not supplied with the switch house, and they must be ordered extra, if desired.

**Prices** will be quoted on request.

OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued



SWITCH-HOUSE WITH PERIODIC-RECLOSING TYPE B-13 OIL CIRCUIT-BREAKER FOR 15,000-VOLT SERVICE



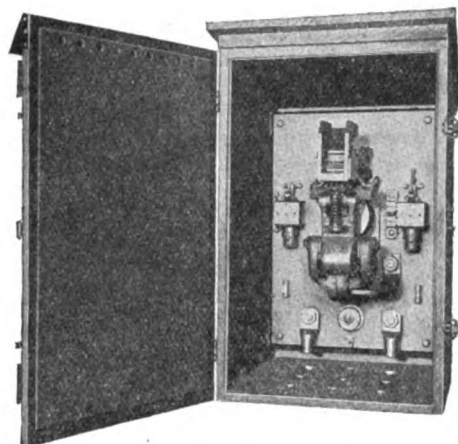
SWITCH-HOUSE WITH PERIODIC-RECLOSING TYPE E-17 OIL CIRCUIT-BREAKER FOR 25,000-VOLT SERVICE



## OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

## AUTOMATIC SECTIONALIZING CONTACTOR

## For Railway and Mining Service

AUTOMATIC SECTIONALIZING CONTACTOR  
BOX CLOSEDAUTOMATIC SECTIONALIZING CONTACTOR  
BOX OPEN

## Application

The Westinghouse automatic sectionalizing contactor is designed for application on railway or mining trolley feeders. It is inserted between feeder sections and prevents an interchange of excessive amounts of power between the sections which it connects. It is fully automatic, opening on overloads and reclosing only when the potential difference between the feeder sections is sufficiently small to limit the flow of current on reclosure to less than the overload setting of the relay.

**Special Applications**—Occasionally special applications may be desired, where service requirements call for slightly different arrangements. For instance, it may be desired to tie two systems together with an automatic sectionalizing contactor so arranged that the power can be fed in only one direction. Such applications should be referred to the Company for complete information.

## Distinctive Features

The automatic sectionalizing contactor has the following distinctive features:

1. It prevents excessive interchange of power between feeder sections.
2. It automatically disconnects that part of trolley or feeder on which overload or short circuit exists.
3. It will not restore service to faulty section until trouble is cleared, but once cleared, it immediately closes the circuit.

## Operation

The equipment which is assembled on the slate

panel and mounted in a weather-proof box consists of the following apparatus:

- |                                |                |
|--------------------------------|----------------|
| Main contactor.                | Holding relay. |
| Overload relay.                | Snap switch.   |
| Fuses, resistor and terminals. |                |

The snap switch which opens or closes the operating circuit is supplied so that when desired the two feeder sections can be disconnected. Also, the contactor will remain open (after being opened) if either section is de-energized by the opening of a section breaker in the substation or power house which feeds that section. When once closed, however, the contactor will not open unless the current flowing exceeds the setting of the overload relay.

Referring to the diagram of connections, the main contactor is normally closed, connecting the two

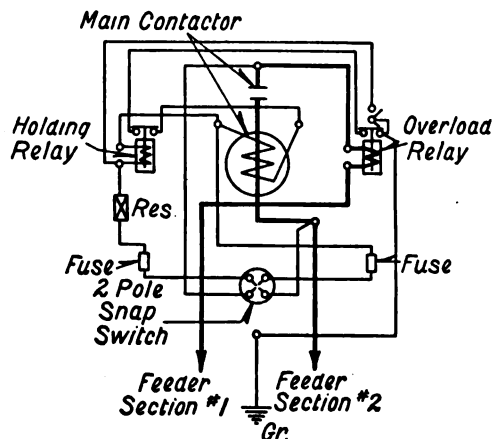


DIAGRAM OF CONNECTIONS

OUTDOOR SWITCH-HOUSES AND METERING EQUIPMENTS—Continued

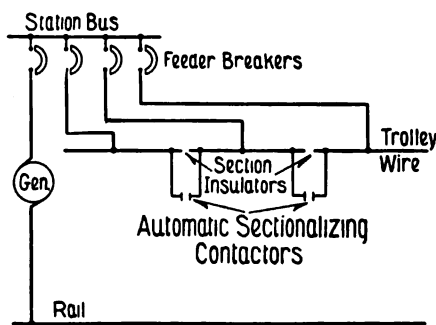
feeder sections together. On the occurrence of an overload exceeding the setting of the overload relay, this relay will operate, opening its lower and closing its upper contacts. The opening of the lower contacts de-energizes the operating coil of the main contactor, causing the contactor to open. At the same time, the closing of the upper contacts energizes the coil of the holding relay, causing this, in turn, to open its contacts.

When the main contactor opens, the overload relay is de-energized and immediately resets. If the voltage difference between the two feeder sections (the voltage across the contactor) exceeds a given minimum, the holding relay will remain energized, as its coil (with resistance in series) is connected directly across the contactor, thus preventing the contactor from reclosing. When the voltage difference drops below the minimum value, however, the holding relay is de-energized and causes the contactor to reclose. This feature prevents the reclosure of the contactor unless it is safe to do so; that is, if it does reclose, the current flow from one section to the other will not exceed the overload setting of the relay and cause the contactor to immediately reopen. In this way, sections of feeders on which faults occur, can be cut off from other sections automatically and then be automatically reconnected as soon as the fault is cleared and voltage restored.

Construction

The apparatus, assembled on a slate panel, is mounted in a wooden box for outdoor service. The box is lined on all sides and on the top with heavy sheet asbestos. Holes are drilled in the bottom for bringing in the cables. Snap hasps for holding the door snugly closed, as well as a staple and hasp for a padlock are also provided. Suitable hanger irons for suspending the box from the cross arm of a pole are mounted on the rear of the box.

The main contactor is of the clapper type, with a blow out coil and arc chute which has proved very reliable and rugged in steel mill and automatic substation work. It is rated conservatively so that a considerable overload can be carried for short intervals.



The overload and holding relays are similar to each other (except for the coils) and are simple and reliable in operation. The overload relay has a series overload coil, while the holding relay has a shunt operating coil. Both are automatically reset, the moving core dropping back by gravity (and spring pressure) when the operating coil is de-energized.

The terminals are located in a convenient position at the bottom of the panel, just above the holes in the floor of the box so that cables can be easily brought in and connected.

Capacities

The automatic sectionalizing contactor can be supplied in six capacities: 125, 250, 350, 500, 800 and 1250 amperes for either 275 or 600-volt service. Other capacities can be supplied in special cases.

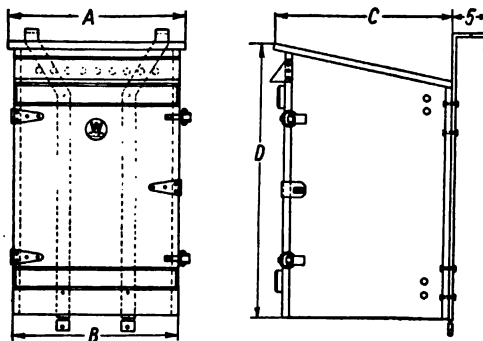
The overload relay has an operating range of from one to two, so that the relay can be set for any desired load within wide limits. The holding relay can be arranged to release and allow the main contactor to close on a difference of potential between feeder sections of from approximately 30 volts to 100 volts or higher if desired.

Prices

List price includes the automatic sectionalizing contactor and house as described and of the corresponding capacity.

Capacity Amperes	List Price
125	\$380 00
250	395 00
350	420 00
500	440 00
800	500 00
1250	680 00

Outline Dimensions



Capacity Amperes	DIMENSIONS IN INCHES			
	A	B	C	D
125	20 1/4	18 3/4	18	30
250	20 1/4	18 3/4	18	30
350	20 1/4	18 3/4	21 1/4	37 1/2
500	20 1/4	18 3/4	21 1/4	37 1/2
800	20 1/4	18 3/4	22 3/4	37 1/2
1250	24 1/4	22 3/4	24 1/2	37 1/2

These dimensions are for reference only. For official dimensions refer to nearest district office.

## CONTROL DESKS

### SECTIONAL TYPES

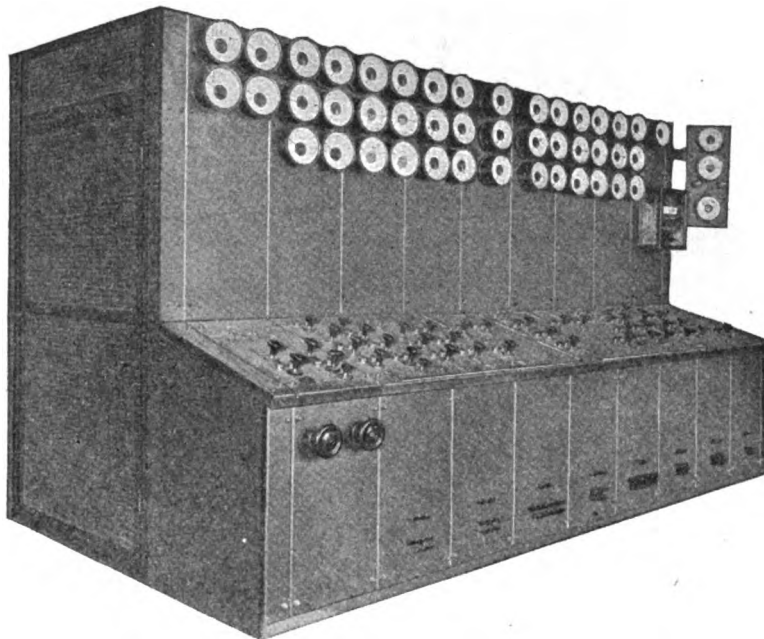


FIG. 1—TYPE D-3 CONTROL DESK WITH SPECIAL ENCLOSURE OF REAR

Under conditions where space economy is an important consideration, a control desk may often be used to advantage for the mounting of control apparatus. Standard control desks are sectional in form, each section being a unit in itself corresponding to the panels of a switchboard.

The desks are built up on a pipe framework having a channel-iron base. The design is such that sections can be easily added to an existing desk by moving one or both end sections and without disturbing apparatus already installed. The top sections are of slate and the sides of steel. Black marine finish is standard for both top and sides to correspond with standard finish of controlling devices and indicators. Access to the desk for wiring is afforded either from the rear or sides by means of cover plates which are easily removed.

These desks can be supplied in four standard types to suit varying conditions. The four types are as follows:

**Type D-1**—This is a plain desk having no provision for instruments. The desk may be located at any convenient place in the station and still permit of an uninterrupted view. Instruments are generally mounted on a supplementary panel switchboard or on instrument posts or frames to suit local conditions.

**Type D-2**—A desk of this type includes an instrument frame mounted on posts as shown in Figs. 2, 7, and 8. The frame is supported at such a height as to permit of a view of the station floor. The instrument frame is also of pipe construction with slate panel sections of width to

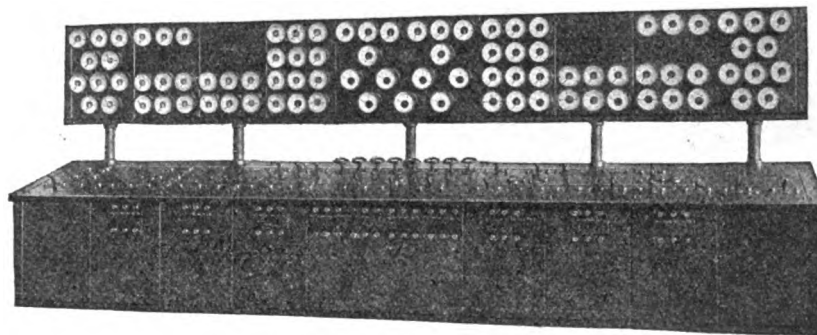


FIG. 2—TYPE D-2 CONTROL DESK

2-323A

## CONTROL DESKS—Continued

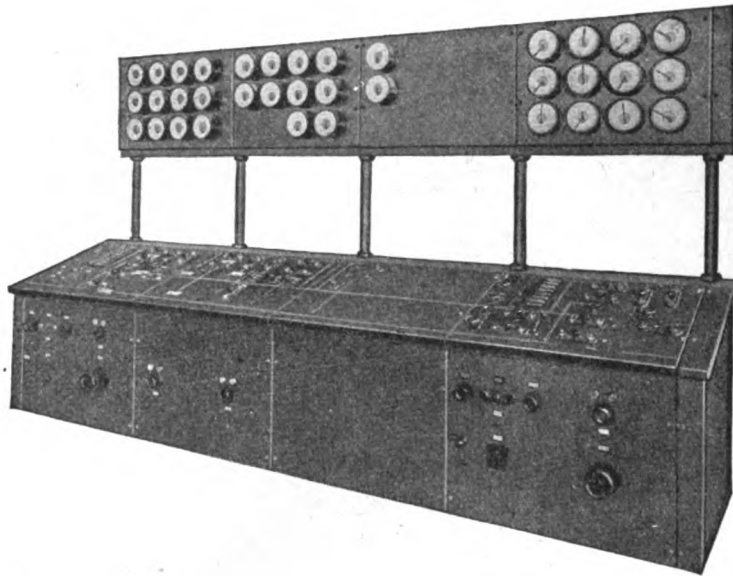


FIG. 3—TYPE D-4 CONTROL DESK

correspond with those of the desk top. The posts supporting the frame are hollow, instrument leads being brought up through them from the desk below. Instrument section and frame are included with the desk section.

**Type D-3**—This type of desk has an instrument section extending upwards from the rear edge of desk top, without intervening space. Section of desk includes corresponding instrument section. This type of desk is commonly combined with a panel switchboard which is indicated by the dotted outline in Fig. 9. The panel switchboard is special and is not included with the desk.

The standard sizes of sections listed below will be found to meet most conditions. No controlling de-

VICES or instruments have been listed with the desk sections, as the combinations used are widely different.

**Type D-4**—This desk is a special form of the type D-2 desk preferred by some purchasers and can be supplied when desired. The price is slightly higher than for the type D-2.

Prices on desks to suit special conditions will be furnished on application.

**Packing**—Desks are packed in sections 4 to 11 feet in length, except for export shipment, in which case desks are shipped knocked down. For approximate shipping weight for export add four times the allowance for packing material given below.

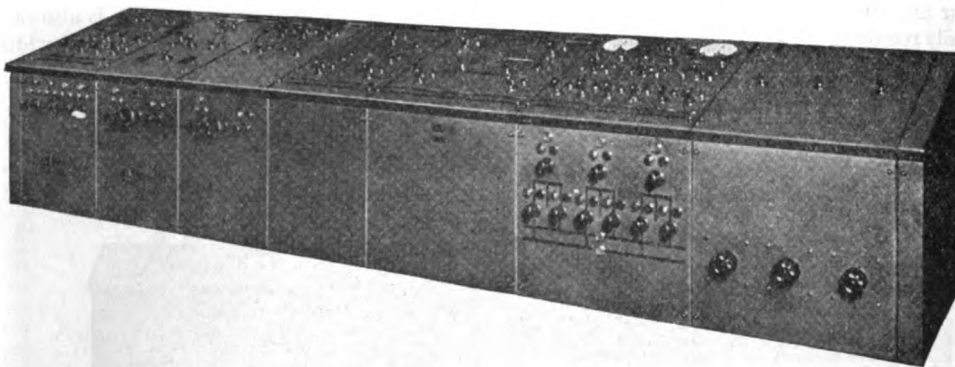


FIG. 4—TYPE D-1 CONTROL DESK

## CONTROL DESKS—Continued

## STYLE NUMBERS

## Type D-1 Desks

Style number and list price include complete section, with channel-iron base.

Style No.	Description	Approx. Weight Net* Lbs.	List Price
<b>Desk With Top 20 Inches Deep</b>			
191010	Set of right and left-hand ends	70	\$390 00
191011	Section 16 inches long	120	250 00
191012	Section 20 inches long	140	260 00
191013	Section 24 inches long	170	275 00
191014	Section 32 inches long	220	290 00
<b>Desk With Top 32 Inches Deep</b>			
191015	Set of right and left-hand ends	90	410 00
191016	Section 16 inches long	160	270 00
191017	Section 20 inches long	200	285 00
191018	Section 24 inches long	240	300 00
191019	Section 32 inches long	310	325 00

\*Approximate shipping weight—Add 75 pounds per foot length to net weight.

## Type D-2 Desks

Style number and list price include complete section with channel-iron base of desk, and channel iron, top iron, and frame for instruments.

Style No.	Description	Approx. Weight Net* Lbs.	List Price
<b>Desk With Top 28-Inches Deep</b>			
191020	Set of right and left-hand ends	135	\$535 00
191021	Section 16 inches long with post	290	415 00
191022	Section 20 inches long with post	340	435 00
191023	Section 24 inches long with post	410	455 00
191024	Section 32 inches long with post	520	500 00
191025	Section 16 inches long plain	250	345 00
191026	Section 20 inches long plain	300	365 00
191027	Section 24 inches long plain	370	385 00
191028	Section 32 inches long plain	480	425 00
<b>Desk With Top 40-Inches Deep</b>			
191029	Set of right and left-hand ends	165	550 00
191030	Section 16 inches long with post	330	435 00
191031	Section 20 inches long with post	400	465 00
191032	Section 24 inches long with post	470	485 00
191033	Section 32 inches long with post	600	540 00
191034	Section 16 inches long plain	290	370 00
191035	Section 20 inches long plain	360	395 00
191036	Section 24 inches long plain	430	415 00
191037	Section 32 inches long plain	560	475 00

\*Approximate shipping weight—Add 125 pounds per foot length to net weight.

For number of plain sections and numbers of sections with post required to make up a desk, consult outline drawing on following pages.

## Type D-3 Desks

Style number and list price include complete section with channel-iron base, instrument section, and top iron.

Style No.	Description	Approx. Weight Net* Lbs.	List Price
<b>Desk With Top 20 Inches Deep</b>			
191038	Set of right and left-hand ends	150	\$590 00
191039	Section 16 inches long	320	405 00
191040	Section 20 inches long	400	430 00
191041	Section 24 inches long	480	460 00
191042	Section 32 inches long	630	520 00
<b>Desk With Top 32 Inches Deep</b>			
191043	Set of right and left-hand ends	190	615 00
191044	Section 16 inches long	370	420 00
191045	Section 20 inches long	460	455 00
191046	Section 24 inches long	550	505 00
191047	Section 32 inches long	715	550 00

\*Approximate shipping weight—Add 125 pounds per foot length to net weight.

Order by Style Number

CONTROL DESKS—Continued

Type D-4 Desk

Style number and list price include complete section with channel-iron base of desk, and channel iron, top iron, and frame for instruments.

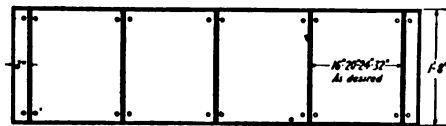
Style No.	Description	Approx. Weight Net* Lbs.	List Price
<b>Desk, With Top 32 Inches Deep</b>			
292443	Set of right and left-hand ends	150	\$615 00
292444	Section 16 inches long with post	320	480 00
292445	Section 20 inches long with post	370	500 00
292446	Section 24 inches long with post	450	525 00
292447	Section 32 inches long with post	570	575 00
292448	Section 16 inches long plain	275	400 00
292449	Section 20 inches long plain	330	420 00
292450	Section 24 inches long plain	400	445 00
292451	Section 32 inches long plain	530	490 00

\*Approximate shipping weight—Add 125 pounds per foot lengths to net weight.

Order by Style Number

OUTLINE DIMENSIONS

Type D-1 Desks



No. of Sections as required

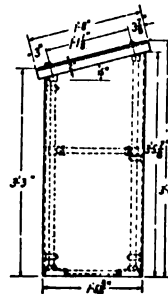
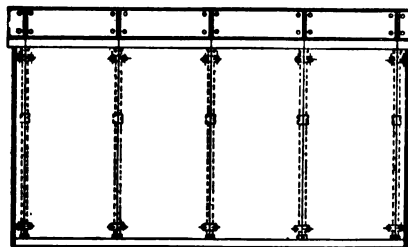
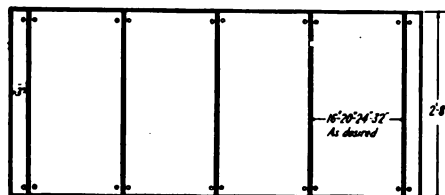


FIG. 5—TOP 20 INCHES DEEP



No. of Sections as required

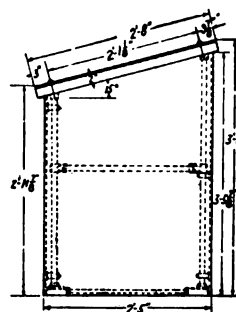
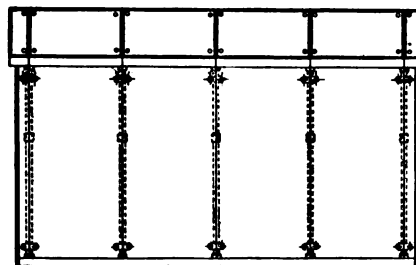


FIG. 6—TOP 32 INCHES DEEP

CONTROL DESKS—Continued

OUTLINE DIMENSIONS

Type D-2 Desks

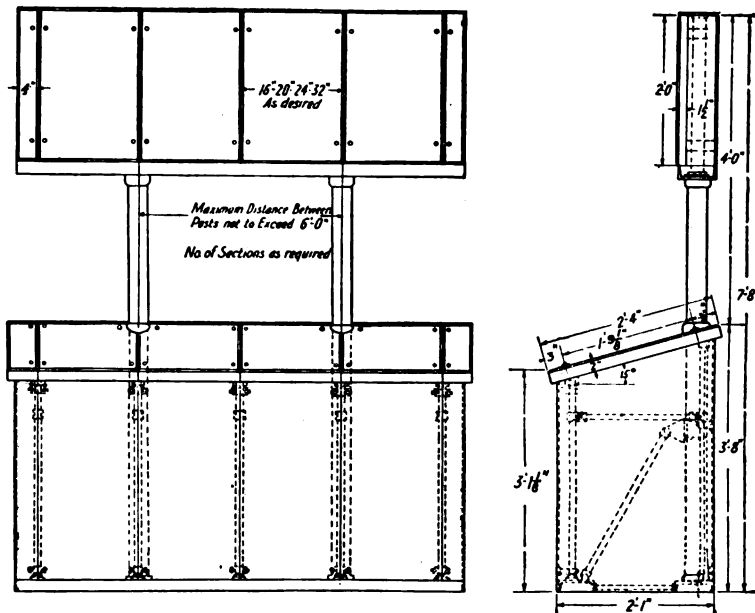


FIG. 7—TOP 28 INCHES DEEP

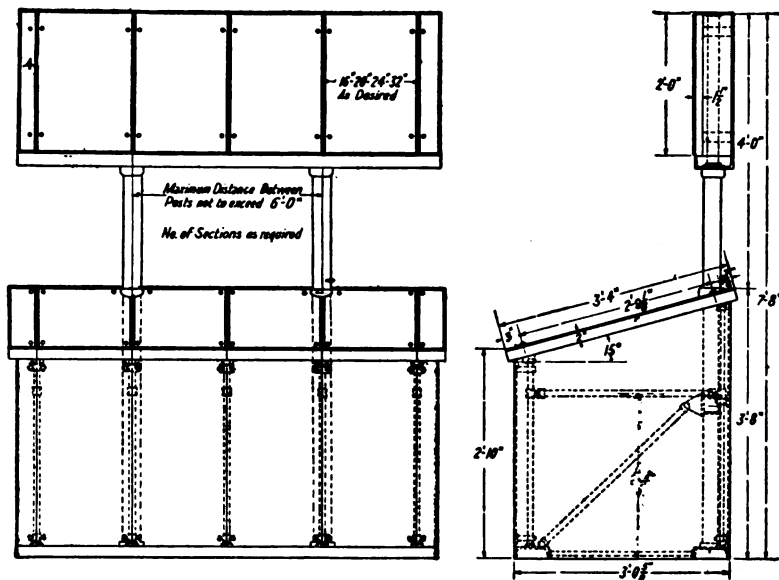


FIG. 8—TOP 40 INCHES DEEP

CONTROL DESKS—Continued  
 OUTLINE DIMENSIONS

Type D-3 Desks

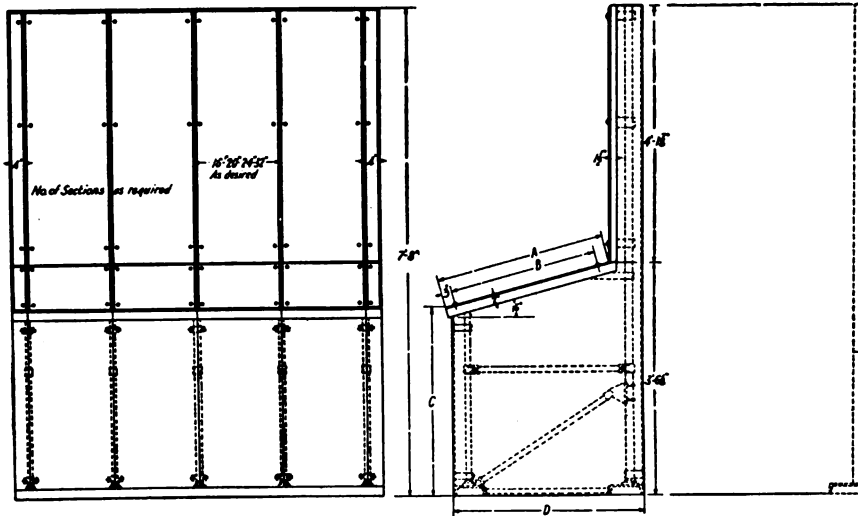


FIG. 9—TOPS 20 AND 32 INCHES DEEP

Type	Fig.	DIMENSIONS IN INCHES			
		A	B	C	D
D-3	9	20	13 $\frac{1}{4}$	37 $\frac{1}{4}$	25
D-3	9	32	25 $\frac{1}{4}$	33 $\frac{1}{4}$	36 $\frac{1}{4}$

Type D-4 Desks

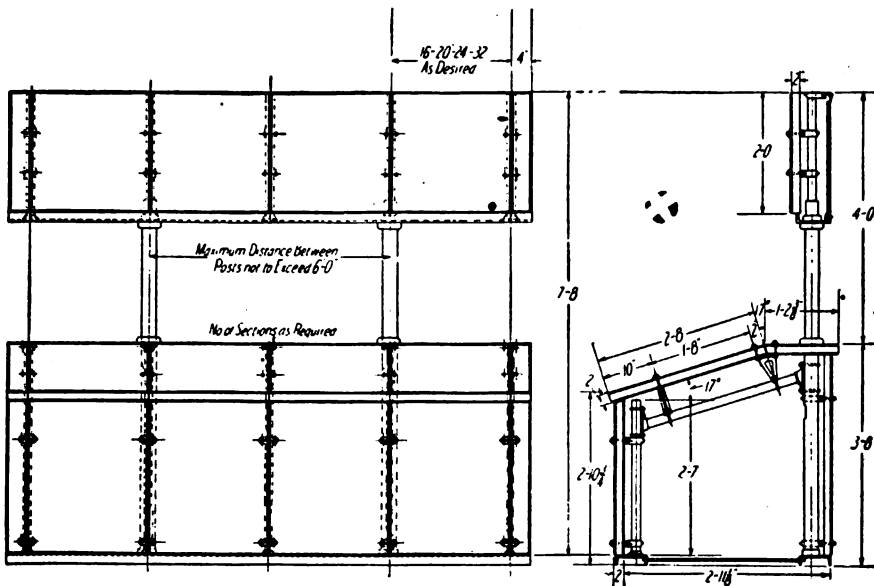
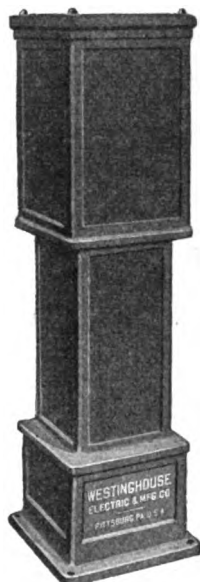


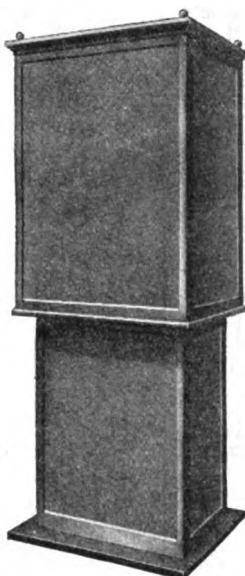
FIG. 10—TOP 32 INCHES DEEP



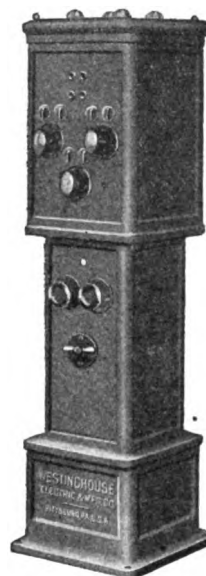
## CONTROL PEDESTALS



STYLE No. 190669



STYLE No. 190668



CONTROL PEDESTAL WITH CONTROL EQUIPMENT

These control pedestals are installed in connection with instrument posts for the control of generator or feeder circuits. Generator and feeder switches, motor-operated rheostats, and motor-operated engine governors are controlled by means of drum-type control switches, and their condition is indicated by lamp indicators, which are mounted on the control pedestal.

Control pedestals installed in connection with instrument posts allow the switchboard operator a clear view of the station and operating machinery. When each pedestal controls a generating unit, there is less liability of an operator getting confused and manipulating the circuits of the wrong generator than where the apparatus for all the generators is assembled on a single switchboard.

The conditions in different power stations are so

varied that it is impossible to list a control pedestal with equipment suitable for one generator, so a list is given of the pedestals only and a size should be selected to contain the control switches and indicators required. Dimensions of the pedestals are given on the following page and dimensions of control switches and indicators are given in this section of the catalogue. Plugs and receptacles are mounted on the pedestals when one instrument serves several generators and for synchronizing.

Connecting wires are run through the floor inside the pedestal, a door in the back giving access to the connections.

Pedestal frames are finished in dull black and trimmings are in black marine. Black marine finished slate top and panels are considered standard, but Blue Vermont or White Italian marble can be supplied if desired.

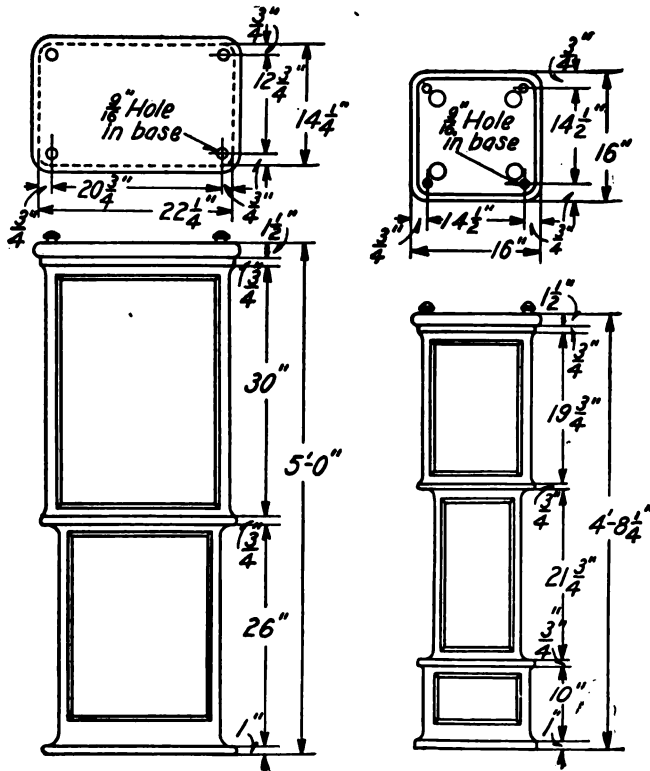
**Style number and list price include pedestal with panels and top but without instruments.**

Size	Panels and Top	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
Large	Slate, black marine finish	450	500	190668	\$455 00
Small	Slate, black marine finish	350	400	190669	295 00
Large	Blue Vermont marble	450	500	91703	535 00
Small	Blue Vermont marble	350	400	91704	400 00
Large	White Italian marble	450	500	190670	750 00
Small	White Italian marble	350	400	190671	500 00

*Order by Style Number*

CONTROL PEDESTALS—Continued

OUTLINE DIMENSIONS



STYLE NOS. 91703, 190668 AND 190670      STYLE NOS. 91704, 190669 AND 190671

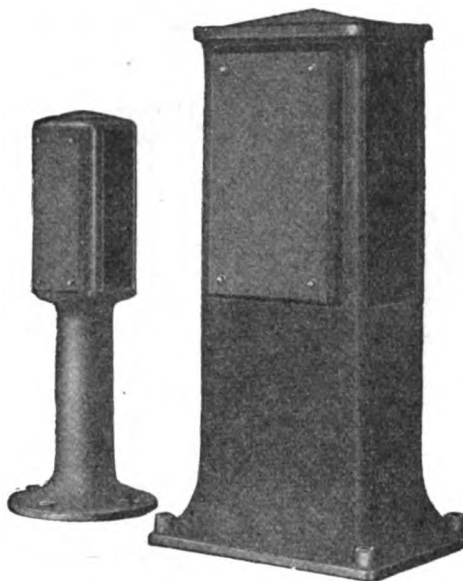
The available space for mounting apparatus on pedestal, Style Nos. 91703, 190668 and 190670 is 2 feet 3½ inches by 1 foot 7¼ inches on the upper panel and 1 foot 10¼ inches by 1 foot 4½ inches on the lower panel; also, approximately 1 foot 9¾ inches by 1 foot 1¾ inches on top horizontal panel.

The available space for mounting apparatus on pedestal, Style Nos. 91704, 190669 and 190671 is 1 foot 5¼ inches by 11¼ inches on the upper panel, and 1 foot 7¼ inches by 8½ inches on the lower panel; also, approximately 1 foot 1¾ inches by 1 foot 1¾ inches on top horizontal panel.

## EQUALIZER PEDESTALS



EQUALIZER PEDESTAL  
WITH SWITCH



STYLE NOS. 7250 AND 15185 EQUALIZER PEDESTALS

These pedestals are designed to support equalizer switches for compound-wound direct-current generators, or synchronous converters. They permit the installation of the switch near the machine, thus saving the expense of long heavy cables to the switchboard.

The type A rear connected, single-pole, single or double-throw, knife switches without quick-break attachment or fuse connections are suitable for equalizer switches.

Double-throw switches are required only where there is a double set of bus-bars.

The capacity of the equalizer switch is usually chosen approximately one-half of the capacity of the main generator or synchronous converter switches, but the relative capacity of the main and equalizer cables is dependent upon the conditions of installation.

It is imperative that the equalizer connection be of low resistance in order to be effective in balancing the load between the machines. By installing equalizer pedestals, the reduction in length of cable to the switchboard results not only in saving the cost of the cable, but also gives a low resistance connection with consequent effective results in equalizing the load.

Fuses and automatic circuit-breakers are omitted from equalizer leads. They are not necessary for protecting the machine since any current that reaches the switchboard bus-bars flows through some protective device connected in a positive or negative generator or synchronous converter lead.

In case a fuse or circuit-breaker is connected in the equalizer circuit and it opens the circuit, the generators or converters must necessarily operate with unbalanced fields, one machine taking all the load, which eventually results in shutting down the entire station. These equalizer pedestals, therefore, are designed for mounting the equalizer switch only.

Dimensions of pedestals are given on the following page. The switch required for the generator or converter capacity is first selected and a pedestal with panel of proper size for mounting this switch will be found in the list on this page. Pedestals differ in size of the opening for the cable; this dimension is shown in the illustrations on the following page.

The style number and list price include the pedestal and marble base without switch. The finish of the entire pedestal is black marine.

Style No.	Size of Throat Inches	Size of Marble Inches	APPROX. WT., LBS.		List Price
			Net	Boxed	
7250	6 1/4 diam.	7x19	175	400	\$125 00
92790	8 1/4 x 16 1/4	10x22	410	700	230 00
15185	12 x 19	15x26	565	750	320 00

Slate, finished in black marine, will be supplied at a decrease in list price as follows:

Size of Marble, Inches	Deductions
7x19	\$ 7 00
10x22	10 00
15x26	18 00

Polished White Italian or Blue Vermont marble will be supplied at the following additions to list price:

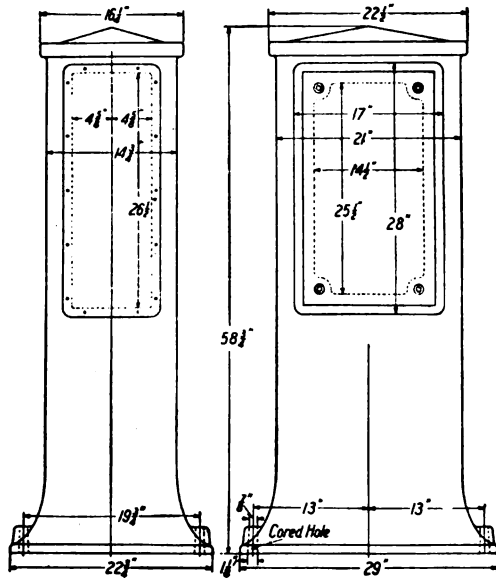
Size of Marble, Inches	White Italian	Blue Vermont
7x19	\$38 00	\$10 00
10x22	59 00	16 00
15x26	87 00	26 00

Order by Style Number

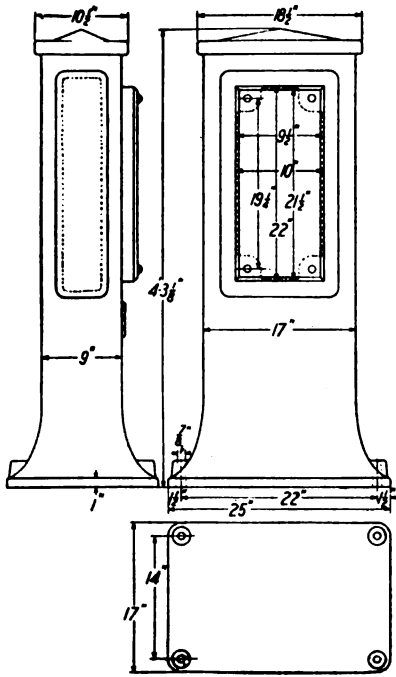
2-329A

EQUALIZER PEDESTALS—Continued

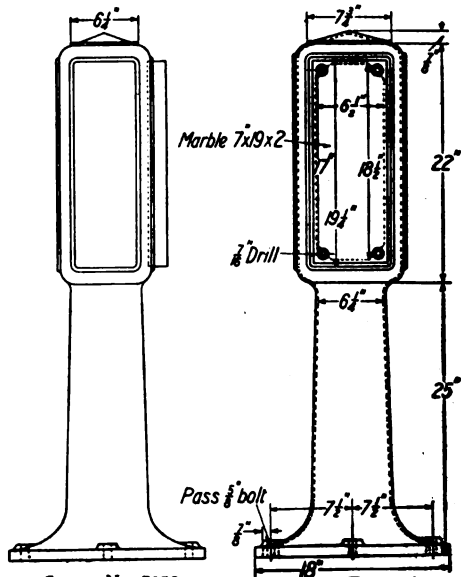
OUTLINE DIMENSIONS



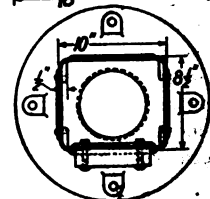
STYLE No. 15185



STYLE No. 92790



STYLE No. 7250



2-339A

# RHEOSTAT PEDESTALS

## WITH AND WITHOUT BASE FOR FIELD SWITCH

These pedestals are used for mounting rheostat handwheels when the rheostats are too large to be mounted on the switchboard or when such mounting is not convenient.

Each of the styles listed consists of a single iron casting finished in dull black, and a handwheel in black marine. The standard styles having bases for switches are supplied with black marine-finished slate panels one and one-quarter inch thick. Polished blue Vermont marble bases can be substituted at an additional list price of \$2.50 each. The **style number and list price** of each style include pedestal handwheel, coupling, and shaft of length given below, but does not include drilling for any switch.

When the rheostat faceplates are to be mounted horizontally directly below the pedestal, no additional material is required. Frequently, however, it becomes necessary to operate the rheostat through bevel gearing, chain-and-sprocket mechanism, or a combination of the two, in which case a sketch showing the required arrangement should be submitted to the nearest district office for a quotation.



STYLE No. 24051

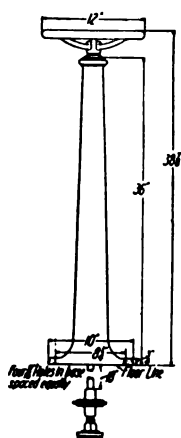


STYLE No. 215799

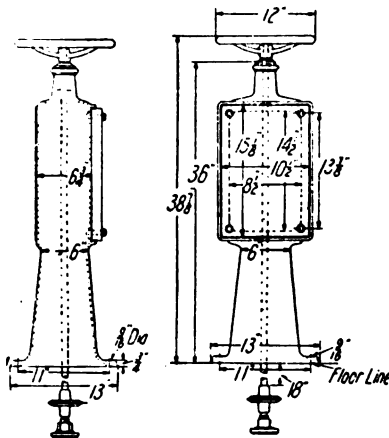
Description	Style No.	List Price
Pedestal with handwheel and shaft	24051	\$135 00
Pedestal with handwheel and shaft and one 15 7/8 x 10 1/2 inch switch base	215799	240 00
Pedestal with handwheel and shaft and one 12 3/4 x 8 5/8 inch switch base	215800	230 00
Pedestal with handwheel and shaft and one 8 1/2 x 8 5/8 inch switch base	215801	215 00
Pedestal with handwheel and shaft and two 8 1/2 x 8 5/8 inch switch bases	215802	225 00

Style No.	List Price
24051	\$135 00
215799	240 00
215800	230 00
215801	215 00
215802	225 00

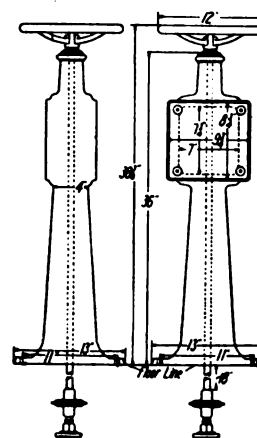
### OUTLINE DIMENSIONS



STYLE No. 24051



STYLE No. 215799



STYLE Nos. 215800, 215801, 215802

### Dimensions in Inches

Style No.
215800
215801
215802

Size of Switch Base
12 3/4 x 8 5/8
8 1/2 x 8 5/8
8 1/2 x 8 1/4

Size of Opening in Switch Base Casting
7x12
7x 7 1/4
7x 7 1/4

Order by Style Number

## SIGNAL PEDESTALS AND SIGNAL SWITCHING SETS

### Column-Type

**Application**—This column type of signal pedestal equipment is designed to provide signal communication between switchboard operators and engine room operators.

Several methods of signaling are in use, but the common application of lamp signals requires two signal switching sets for each generator. One of these sets is mounted at the control desk or switchboard; the other in the signal pedestal and located convenient to the machine. In addition, one bell relay, one electrically-operated gong or whistle and the necessary wiring must be provided for the station. In some cases the gong or whistle is paralleled with an illuminating signal set for the engine room.

The **signal switching set** includes a number of three-way push switches with their indicating lamps and plates. It is suitable for mounting in the pedestal, as shown in the figure, or on a control desk or switchboard.

The **signal pedestal** includes a pedestal complete with a signal set, but unwired.

Wiring, relays, or alarm bells are not included in the style number.

#### Pedestal With Signal Switching Set

Style No.	No. of Switches and Indicating Plates	List Price
292469	6	\$300 00
292470	8	350 00

#### Signal Switching Set

Style No.	No. of Switches and Indicating Plates	List Price
292471	6	\$200 00
292472	8	250 00

### Panel-Type

**Application**—This panel type of pedestal can be used for mounting signal systems and other power station accessory equipments, which for convenience, it is desirable to locate apart from the control desk or main switchboard. The accompanying illustration shows a pedestal used for a potentiometer temperature indicator equipment with twelve drum-type potentiometer switches.

Some of the classes of equipment to which these pedestals are readily applicable are:

Signal systems of almost every kind used in a power station.

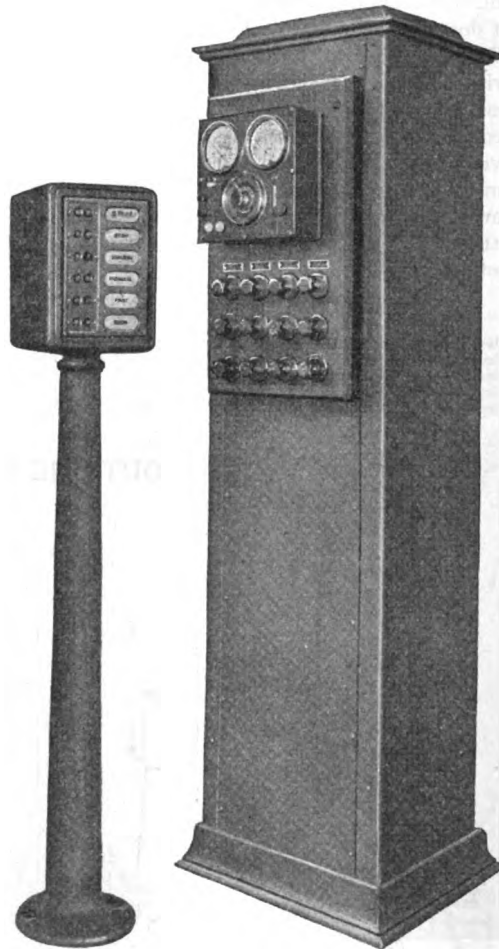
Combinations of indicating electrical instruments or gages at the machines or at other places apart from the main switchboard.

Drum-type control switches with lamps, for indicating their positions, for the remote electrical control of circuit-breakers and rheostats.

Complete switching and metering equipment for the control of small isolated generators or feeders.

**Construction**—These pedestals can be furnished with panels sixteen inches wide and in varying heights up to a maximum of sixty-five inches, thus permitting the mounting on them of many pieces of apparatus.

Further information will be furnished on request.

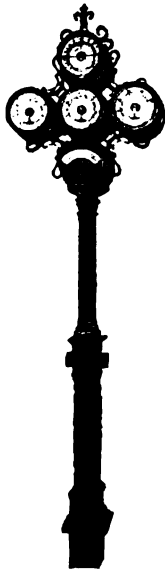


COLUMN-TYPE  
PEDESTAL WITH SIGNAL  
SWITCHING SET

PANEL-TYPE PEDESTAL  
WITH TEMPERATURE INDICATING  
EQUIPMENT

## INSTRUMENT POSTS

FOR ELECTRICALLY-OPERATED CONTROL OUTFITS



STYLE No. 93510  
STATIONARY TYPE INSTRUMENT POST WITH ORNAMENTAL BASE



STYLE No. 108991  
SWIVEL TYPE INSTRUMENT POST WITH PANELLED BASE



STYLE No. 93531  
STATIONARY TYPE INSTRUMENT POST WITH PANELLED BASE



STYLE No. 292452  
INSTRUMENT PANEL POST WITH PLAIN BASE

**Application**—These instrument posts are used whenever a device is required upon which to mount instruments in a power station in place of using an instrument switchboard. The wiring is concealed in the interior of the posts.

They permit of a very convenient and ornamental mounting for instruments and enable locating the instruments so that they can be readily observed without obstructing the general view of the operator.

The instrument panel posts provide a convenient method for mounting station instruments.

**Arrangement**—The usual arrangement is to place these posts so as to form a support for the railing of an operating gallery, each post being placed in front of its respective controlling apparatus, which is usually located on a suitable controlling pedestal.

**Erection**—The posts may be secured to the floor either by bolting the shank to the side of channel iron beams located under the floor, or by using a bolted flange collar, secured to the post and provided with holes for holding-down bolts. When a concrete floor is provided, a socket can be supplied which may be set into the floor, and which is arranged for bolting to the flange collar. It is necessary in ordering these posts to specify which style is required, otherwise the standard post will be supplied provided with the flange collar.

It is also necessary to specify if provision is to be made for a hand railing. The standard ornamental

posts as listed have plates provided at the places where hand railing is usually attached, but when required hand rail bosses may be substituted without additional cost. These bosses are drilled to take a standard 2-inch pipe,  $2\frac{3}{8}$  inches outside diameter. They will not be supplied unless specially ordered. Posts with panel bases cannot be arranged for hand railing.

**Pedestals**—Two styles of pedestals are listed: those with ornamental bases and those with panelled bases suitable for mounting control apparatus. Each of these styles is also listed with stationary top and with swivel top which can be turned about by means of a handwheel just above the base.

**Finish**—The posts as listed by style numbers are finished in dead black. The posts having panelled bases are supplied with panels of slate with black marine finish.

The style number and list price do not include instruments or drilling for instruments, and if the posts are to be drilled a sketch should be supplied with the order specifying the drilling required. The posts will be drilled without charge if sufficient information for the purpose is received with the order.

The posts for 7 and 9-inch instruments are identical except that the style numbers for posts for 7-inch instruments include adapter plates to permit mounting the smaller instruments.

INSTRUMENT POSTS—Continued

PRICES

Number of Round Meters	Additional Meters	Posts for 7-inch Meters Style No.	List Price	Posts for 9-inch Meters Style No.	List Price
<b>Ornamental Base—Stationary Type</b>					
5	.....	192544	\$475 00	93510	\$500 00
6	.....	192545	560 00	93511	585 00
7	.....	192546	580 00	93512	610 00
8	.....	192547	600 00	93513	630 00
9	.....	192548	675 00	93514	710 00
4	One type GL or GM meter	192549	500 00	93515	500 00
5	One type GL or GM meter	192550	570 00	93516	590 00
<b>Ornamental Base—Swivel Type</b>					
5	.....	192552	620 00	93518	655 00
6	.....	192553	720 00	93519	740 00
7	.....	192554	735 00	93520	765 00
8	.....	192555	750 00	93521	790 00
9	.....	192556	760 00	93522	850 00
4	One type GL or GM meter	192557	635 00	93523	655 00
5	One type GL or GM meter	192558	735 00	93524	755 00
<b>Panelled Base—Stationary Type</b>					
5	.....	192559	550 00	93527	575 00
6	.....	192560	635 00	93528	660 00
7	.....	192561	655 00	93529	690 00
8	.....	192562	675 00	93530	710 00
9	.....	192563	740 00	93531	785 00
4	One type GL or GM meter	192564	550 00	93532	565 00
5	One type GL or GM meter	192565	640 00	93533	665 00
<b>Panelled Base—Swivel Type</b>					
5	.....	192567	775 00	108989	800 00
6	.....	192568	850 00	108990	875 00
7	.....	192569	895 00	108991	920 00
8	.....	192570	900 00	108992	935 00
9	.....	192571	990 00	108993	1000 00
4	One type GL or GM meter	192572	780 00	108994	830 00
5	One type GL or GM meter	192573	900 00	108995	925 00
<b>Instrument Panel Post</b>					
5*	.....	292452	550 00		

\*For larger panels refer to the nearest District Office for description and prices.

Floor Socket

Style No.	Description	List Price
93526	Floor socket for use in concrete floor	\$28 00

DIMENSIONS AND WEIGHTS

STYLE NUMBERS		Top Fig. No.	Base Fig. No.	Total Height	Approx. Wt. Boxed, Lbs.
Posts for 7-inch Meters	Posts for 9-inch Meters				
192544	93510	1	8	8'10 1/8"	760
192545	93511	3	8	8'10 1/8"	810
192546	93512	5	8	9' 0"	860
192547	93513	6	8	9' 0 1/2"	910
192548	93514	7	8	8'11 1/8"	960
192549	93515	2	8	9' 0 1/8"	775
192550	93516	4	8	9' 0 1/8"	825
192552	93518	1	10	8'10 1/8"	900
192553	93519	3	10	8'10 1/8"	950
192554	93520	5	10	9' 0"	1000
192555	93521	6	10	9' 0 1/2"	1050
192556	93522	7	10	8'11 1/8"	1100
192557	93523	2	10	9' 0 1/8"	915
192558	93524	4	10	9' 0 1/8"	965
192559	93527	1	11	8'10 1/8"	825
192560	93528	3	11	8'10 1/8"	875
192561	93529	5	11	9' 0 1/2"	925
192562	93530	6	11	9' 0 1/2"	975
192563	93531	7	11	9' 0"	1025
192564	93532	2	11	9' 0 1/8"	840
192565	93533	4	11	9' 1"	890
192567	108989	1	12	8'10 1/8"	925
192568	108990	3	12	8'10 1/8"	975
192569	108991	5	12	9' 0 1/2"	1025
192570	108992	6	12	9' 0 1/2"	1075
192571	108993	7	12	9' 0"	1125
192572	108994	2	12	9' 0 1/8"	940
192573	108995	4	12	9' 1"	990
292452	.....	13	13	7' 6"	1000

Dimensions given are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number



INSTRUMENT POSTS—Continued

OUTLINE DIMENSIONS

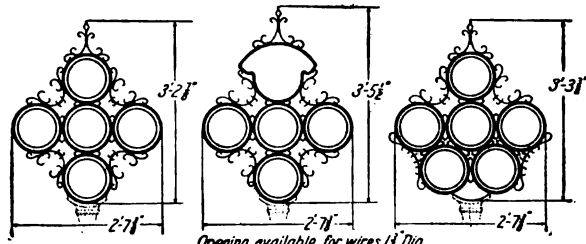


FIG. 1                      FIG. 2                      FIG. 3

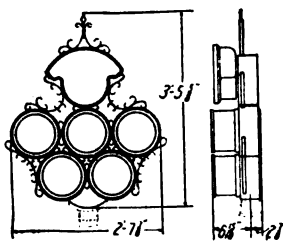


FIG. 4

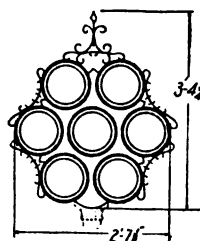


FIG. 5

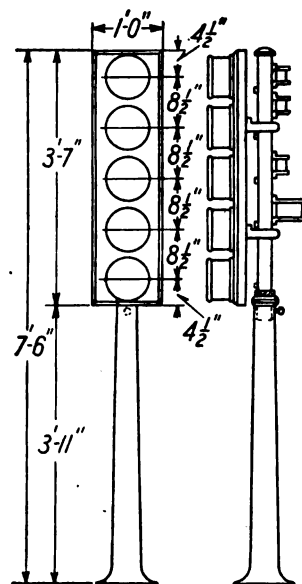


FIG. 13

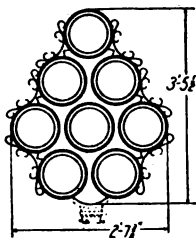


FIG. 6

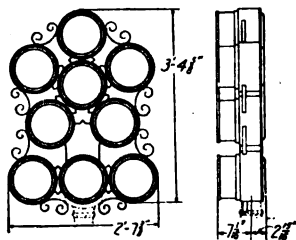


FIG. 7

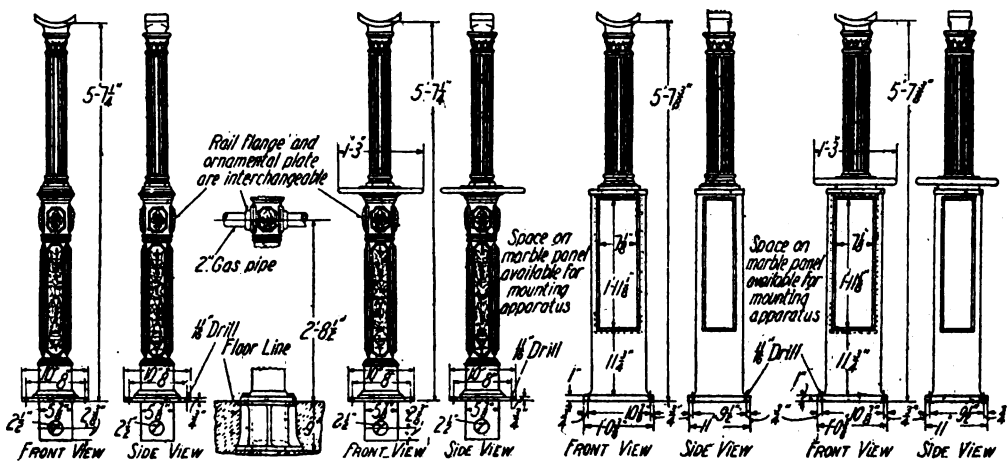


FIG. 8

FIG. 9

FIG. 10

FIG. 11

FIG. 12

## TYPE CS CONTROL SWITCHES FOR MOTOR AND CIRCUIT-BREAKER CONTROL

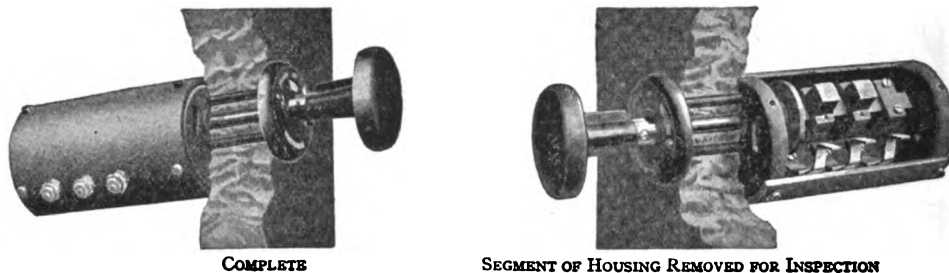


FIG. 1—TYPE CS CONTROL SWITCH

### Application

Type CS control switches have been designed for the control of circuits governing the operation of solenoid-operated switches and circuit-breakers or their control relays, solenoid-operated rheostats, motor-operated rheostats, motor-operated engine and turbine governors, and motor-operated feeder-potential regulators.

The adaptability of the type CS control switch to a variety of special requirements insures a neat and uniform appearance of equipment on the front of the switchboard. As an aid in selection for the switchboard operator, type CS control switches for circuit-breakers are provided with handles of a different shape than the other control switches.

### Ratings

Due to the inductive nature of the circuits usually controlled, these ratings represent, in general, the current interrupting limits rather than the current conducting limits of the controllers.

Control Voltage	Ultimate Interrupting Capacity, Amperes
125 volts, D-C. or A-C.	30
250 volts, D-C. or A-C.	20
600 volts, D-C. or A-C.	5

It will be noted from the table above that the type CS control switches will successfully handle current values of considerable magnitude. However, where the current demands, of closing solenoids in particular, are in excess of these values, a control relay should be interposed between the controller contacts and the solenoid. For specific data covering the application and prices of control relays refer to "Control Relays" in this section.

### Construction

Ruggedness and compactness are salient features of the type CS control switches. Advantage has been taken in their design of the years of successful operation and experience on railway controller contacts. Rugged stamped contact fingers of the same type as employed on railway controllers are used; the advantages of the horn-gap construction inherent in this design are well known.

Movable contact members mounted on a square insulated shaft engage with stationary spring-contact fingers as the shaft is rotated to the right or left. The switching element is housed in a substantial Micarta tube, which provides a simple rigid insulating structure. A segment of the housing is easily removable for inspection and adjustment.

### Mechanical and Electrical Indication

Indicating lamps can be provided for showing the position (closed or open) of the circuit-breaker. The lamps are so connected with the signal switch on the breaker that when the breaker is closed the red indicator lamp is lighted and when the breaker is open the green indicator lamp is lighted.

All control switches for circuit-breakers are provided with a mechanical indicating device that shows the last manual operation of the control switch. When the handle is released, the switch automatically returns to the neutral (central) position.

### Panel Space Economy

The switches with their indicating lamps can be mounted  $3\frac{1}{2}$  inches between vertical center lines and 7 inches between horizontal center lines, or 7 inches between vertical center lines and  $3\frac{1}{2}$  inches between horizontal center lines. Two switches with their indicating lamps may be mounted on even less rectangular space than is required for one 7-inch Westinghouse indicating instrument, the switches being located in either of the above arrangements. This feature is in keeping with modern requirements of space economy for switchboards.

### Signal Lamp Cut-Out

Several designs of switches for the control of solenoid-operated breakers, embodying a signal lamp cut-out, are listed. The oval handle on these switches may be turned past the trip position to a lamp-cut-out position, there latched in place; thus closing the circuit to trip the breaker, and then opening both the trip circuit and the indicating-lamp circuit, leaving the breaker "locked" in the open position. This permits cutting out of all lamps on breakers not in service; the horizontal

## TYPE CS CONTROL SWITCHES—Continued

position of the control handles when set this way being readily observed by the operator.

**Finish**—The operating handle is of black molded material with a polished black finish; the dial-plate markings are polished copper on the raised parts with a black mat background; and the housing is finished in dull black.

### Full Automatic Attachment for Type CS Control Switches

**Application**—The full automatic attachment may be added to any type CS circuit-breaker control switch. By adding this attachment the breaker cannot be held closed on severe overload or short circuit if arranged to trip from current transformer only or from current transformer actuating circuit closing relays. In other words, the breaker is made full automatic, electrically operated.

**Construction**—This attachment consists of a coil, a magnetic circuit, a moving core and a trigger, normally engaging the switch shaft, so arranged

that when the coil is energized (either from d-c. source through relays or from excessive current when connected to current transformers), the core is moved in the direction necessary to release the trigger. This allows the switch shaft to return to the neutral position free of the handle.

**Operation**—When a circuit-breaker is closed on a severe overload or short circuit, the trip-free attachment immediately operates and allows the control switch to return to the neutral or off position simultaneously with the tripping of the breaker. Before the circuit-breaker can again be closed, it is necessary to turn the switch handle to the off position to engage the switch shaft.



FIG. 2—FULL AUTOMATIC ATTACHMENT FOR TYPE CS CONTROL SWITCH

### PRICES

Style number and list price include switch complete as described. Switches "With Lamp Indicators" include: two lamp receptacles, one lens holder with red lens, one lens holder with green lens, and two lamps. All the switches and lamp indicators are arranged for 2-inch mounting.

Spacers are listed below suitable for mounting the devices on 1½-inch or 1¼-inch panels. For such mounting it is necessary to order separately one suitable spacer for each switch and each lamp indicator.

Application	Maximum Voltage of Circuit	Schematic Diagram Fig. Ref.	Dim. A Fig. 3—Inches	Style No.	List Price
<b>Control Switches with Lamp Circuit Cut-out* for Electrically-Operated Oil Circuit-Breakers Without Lamp Indicators</b>					
Standard control switch, single-pole, double-throw.....	600	4	6¼	290440	\$20 00
Same as Style No. 290440 except with extra contacts for relay trip circuit.....	600	5	8¼	290443	24 00
<b>Control Switches Without Lamp Cut-out</b>					
Semi-standard control switch, single-pole, double-throw....	600	6	5¼	290439	18 00
Same as Style No. 290439 except with extra contacts for relay trip circuit.....	600	5 (modified per note)	7¼	290441	21 00
Same as Style No. 290441 except with additional contacts for two systems of relays.....	600	9	8¼	290442	23 00
<b>Control Switches With Lamp Indicators</b>					
Style No. 290439 with 125-volt lamp indicators.....		6	5¼	290444	31 00
Style No. 290440 with 125-volt lamp indicators.....		4	6¼	290445	33 00
Style No. 290439 with 140-volt lamp indicators.....		6	5¼	290446	31 00
Style No. 290440 with 140-volt lamp indicators.....		4	6¼	290447	33 00
<b>Full Automatic Attachment for Type CS Circuit-Breaker Control Switches</b>					
Attachment without coil.....				295672	24 00
Attachment with 125-250-volt d-c., shunt coil.....		7		295673	26 00
Attachment with 15-ampere, 60-cycle, series coil.....		8		295675	26 00
Attachment with 15-ampere, 25-cycle, series coil.....		8		295676	26 00
<b>For Miscellaneous Control—Without Lamp Indicators</b>					
Motor-operated engine governors.....	250†	11 & 12	8¼	271785	25 00
Solenoid-operated rheostats.....	600	13	5¼	271786	19 00
Motor-operated rheostats.....	250†	14	8¼	271787	28 00
Motor-operated feeder-potential regulators.....	250†	10	8¼	271788	30 00
<b>Spacers</b>					
Switch spacer for 1½-inch thick.....	...	::	::	296181	75
Switch spacer for 1¼-inch thick panel.....	...	::	::	296180	75

\*The lamp cut-out permits opening the green lamp circuit when the main circuit is not in normal service.

†The extra contacts break the common relay trip circuit on a two-breaker, double-bus, system when one breaker is tripped by its control switch, thus preventing the tripping of the other breaker.

‡Switches for 600-volt circuits will be made on special order; prices on request.

Order by Style Number

TYPE CS CONTROL SWITCHES—Continued

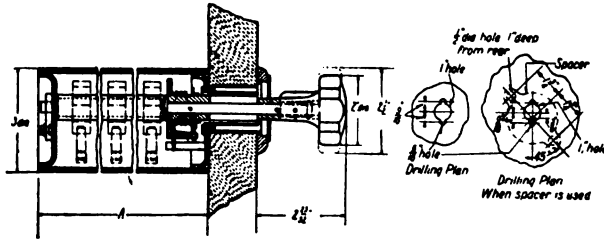


FIG. 3

SCHMATIC DIAGRAMS USING TYPE CS CONTROL SWITCHES

(Shown Looking Down on Switch—Handle End at Top of Diagram)

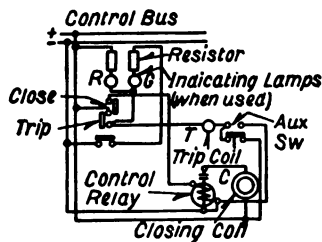


FIG. 4  
Style No. 290440, 290445 and 290447

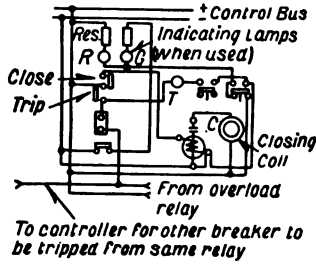


FIG. 5  
Style No. 290441 (with omission of lamp cut-out contacts) and 290443

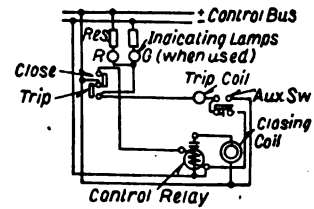


FIG. 6  
Style No. 290439, 290444 and 290446

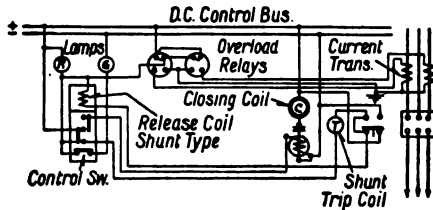


FIG. 7  
Shunt Type—Style No. 295673  
With Switch Style No. 290440

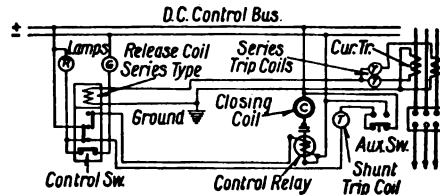


FIG. 8  
Series Type—Style No. 295675 or 295676  
With Switch Style No. 290440

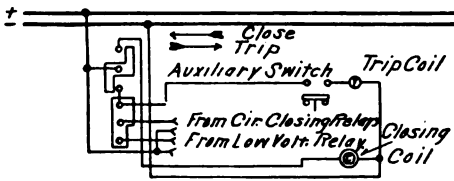


FIG. 9  
Style No. 290442

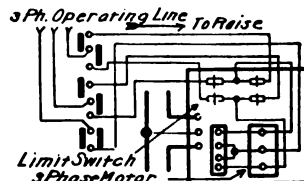


FIG. 10  
Style No. 271788  
For Motor-Operated  
Feeder-Potential Regulators

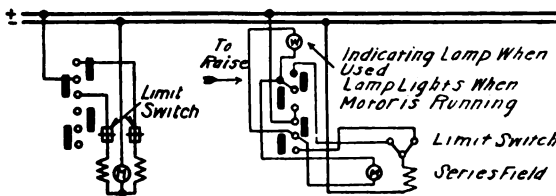


FIG. 11  
Style No. 271785  
Split-Field Motor  
For Motor-Operated Governors

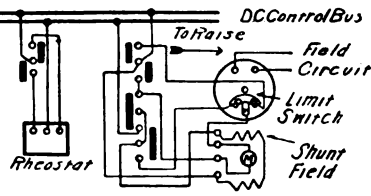


FIG. 12  
Style No. 271786  
Series Motor  
For Motor-Operated Governors



FIG. 13  
Style No. 271786  
For Solenoid-Operated  
Rheostats



FIG. 14  
Style No. 271787  
For Motor-Operated  
Rheostats

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## LAMP INDICATORS

Lamp indicators are connected in the control circuit of electrically-operated circuit-breakers to indicate whether the breaker is open or closed.

They are also used to indicate the condition or position of various electrically-operated apparatus and the continuity of control circuits.

For diagrams of typical connections, see Figs. 7, 8 and 9, and similar diagrams on preceding pages.

**Operation**—The lamps are so connected with the signal switch on the breaker that when the breaker is closed the red indicator will be lighted and when the breaker is open the green indicator is lighted.

**Construction**—Each indicator consists of a receptacle projecting through the switchboard for holding a candelabra lamp, and a lens holder with a special prismatic lens. The lamp is removable from the front of the panel and the receptacle is provided with a glass tube fuse at the back of the board. The lens holder is pushed into the end of the receptacle from the front of the board and is held firmly by spring clips. A special feature of the lens is the

prismatic projection extending across its face, which makes the indications visible from any position in front of the board.

These indicators are arranged for mounting on 2-inch panels, but can be used on 1½-inch and 1¼-inch boards by the addition of an adapter listed.

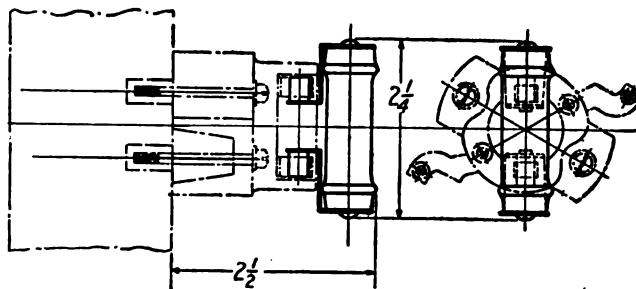
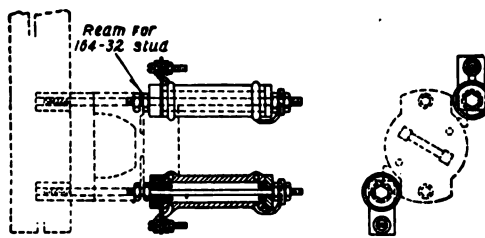
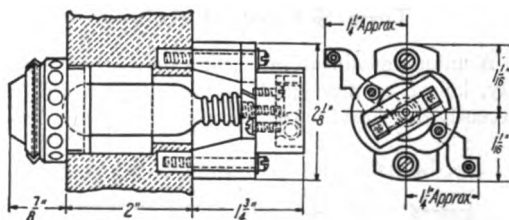
**Style number and list price of receptacle** include receptacle complete with panel ring and rods and tubular fuse but without adapter, lens holder, lens, or lamp. **Style number and list price of lens holder and lens** include the complete part but without receptacle or lamp.

A 125 or 140-volt candelabra screw-base lamp should be used. For control voltages over 140, the 125-volt lamp should be used with suitable resistor (see following table); style number and list price of lamp do not include resistor. Resistor Style No. 186465 consists of a single tube, one resistor being required for each lamp. Resistor Style No. 198626 consists of two tubes, requiring one resistor for each lamp.

Description	Volts	Watts	Style No.	List Price	
Lamp receptacle for 2-inch panel	...	..	286649	\$1 50	
Adapter for using receptacle Style No. 286649 on 1¼ or 1½-inch panels	...	..	156145	25	
Lens holder {	...	...	with red lens	154255	1 75
			with green lens	154256	1 50
			with white lens	154257	1 75
Extra glass-tube fuse	...	...	156096	1 75	
Lamp (Candelabra screw-base T-6 Bulb Type E)	{	...	125	195973	1 70
			140	195974	1 50
			125 (Single Unit 350W)	384962	5 00
			250 (Double Unit 700W each)	384963	6 00

§For prices see Section 1-B.

### Outline Dimensions



These dimensions are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number

2-639A

## CONTROL RELAYS

### FOR OPERATION ON DIRECT CURRENT

**General Application**—Control relays are interposed between the contacts of a main relay or the contacts of a control switch and the apparatus to be controlled, when the current required to operate the apparatus exceeds the current-carrying or interrupting capacity of the main relay or control switch contacts.

Control relays are generally required for the closing-coil circuits of electrically-operated air and oil circuit-breakers.

**Operation**—The operating coil for the control relay is energized from the control circuit by the closing of the control switch, causing the control relay contacts to close. This in turn connects the circuit-breaker closing-coil across the control circuit.

The control relays listed are given a maximum current and voltage rating based on intermittent operation. They will give satisfactory service for intermittent duty, namely, with power impressed thereon for not more than ten seconds out of every sixty; this is the condition found under usual operating requirements.

**Construction**—These control relays are an adaptation of the well known contactor type of switch used most extensively for industrial motor control.

**The contacts**, which have ample overload capacity, are pressed firmly together with a self-cleaning action.

**Flexible copper shunts** carry the current from the moving contact to the lower terminal of the relay. No current passes through pins, springs, or bearing surfaces. The top contact is stationary and, therefore, requires no shunt.

**Blowout coils** of special design to handle the highly inductive breaker solenoids, are used on all control relays. The blowout coils and arcing horns are very efficient in operation. The arc is distrib-

uted over a relatively large area as soon as formed and is quickly extinguished. Hence it has practically no destructive action.

**Arc shields** made of compressed asbestos compound are used on all control relays.

**The operating coil** is wound upon a spool of insulating material that will withstand a temperature of 125 degrees Centigrade. The coil is impregnated so that it forms a homogeneous mass that is unaffected by moisture or high temperature. The winding is so arranged that both terminals are brought out at the surface and at no point is there high voltage between turns.

**The bearing pin** on which the movable arm turns, is of large diameter, so that its life is very long. It, as well as all screws, nuts, bolts, etc., has a sherardized non-corrosive finish.

In order to meet the several methods of control systems, various combinations of control relays are given:

#### Type C Control Relay

The simplest form of control relay is the plain control relay mounted on an individual slate base. Two different sizes of type C control relays are available. Each with operating coils for either 125 or 250-volt nominal control. These coils have a very wide operating range, considerably beyond that of the circuit breaker solenoids. Their general arrangement with outline dimensions is shown in Figs. 1 and 2.

#### Type S Control Relay

A unique modification of the type C control relay, known as the type S control relay, has been recently developed, which provides a trip-free fea-

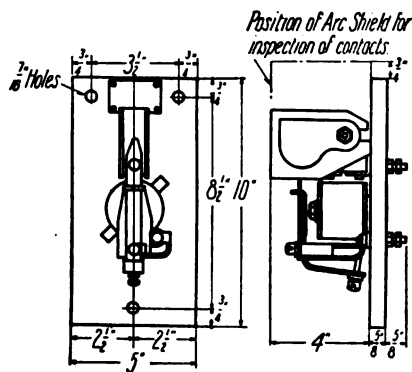


FIG. 1—TYPE 20-C

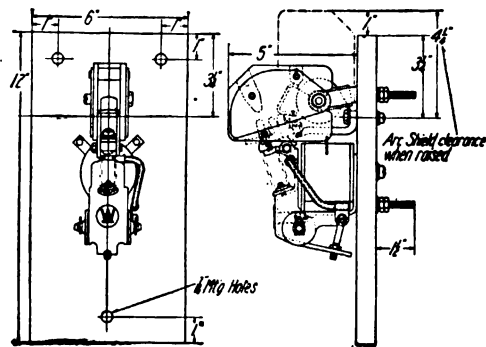


FIG. 2—TYPE 30-C

CONTROL RELAYS—Continued

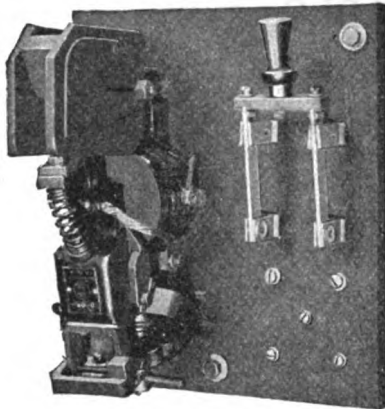


FIG. 3—TYPE S-2 CONTROL RELAY (COVER REMOVED)

ture to the circuit-breaker control system, thus preventing the holding of a breaker closed on a short circuit by the operator.

The control relay is provided with a two-piece contact arm and a release coil. As soon as the circuit breaker is closed by the operator in the usual manner, the pallet switch on the breaker energizes

the release coil of the control relay. This release coil opens the contacts of the control relay, irrespective of the fact that the operator may hold the control switch in the "closed position," and thus still be energizing the main coil of the control relay. This arrangement requires that the operator return the control switch to the "off position" before he can again attempt to close the circuit breaker.

This form of control relay, together with a two-pole knife switch, mounted on a suitable base, is supplied as part of the breaker equipment on some of the larger breakers, as listed in the table, but also can be ordered as extras and added to any of the circuit breakers not regularly equipped.

Type S control relays correspond in capacity to the type 30-C control relay. Two forms of the control panel are available:

Type S-1 includes one type S relay mounted on a suitable panel.

Type S-2 includes one type S relay and one 2 P. S. T. knife switch mounted on a panel having control wire terminals and cover.

The general arrangement of this relay and knife switch with terminal board is shown in Fig. 3.

SPECIFIC APPLICATION DATA FOR WESTINGHOUSE CIRCUIT BREAKERS

In order to assist in choosing the proper control relay, the following list of Westinghouse electrically-operated breakers has been compiled, showing the proper size of control relay to be used.

List of Oil Circuit-Breakers with which Type 20-C Control Relays Should Be Used

Type of Oil Circuit-Breaker	Description
F-2	All sizes
F-3	All sizes including multiple multi-pole combinations
F-22	All sizes
F-33	All sizes
B-a	All sizes
B-2	1500 amperes and lower
B-13	300 and 600 amperes
B-4	.....
E-8 & E-9	300 and 600 amperes

List of Oil Circuit-Breakers with which Type 30-C Control Relays Should Be Used

B-2	2000 amperes and multiple multi-pole combinations
B-13	1200 to 2000 amperes
E-8 & E-9	1200 amperes and higher

Type of Oil Circuit-Breaker	Description
CG	All sizes
C-2	All sizes
G-1 & G-11	Up to 50,000 volts

Some of the larger circuit breakers are regularly supplied with a control relay panel mounted near the solenoid and wired up between the terminal board and the relay closing coil, tripping coil, and one pallet switch.

List of Oil Circuit-Breakers which have Type S-2 Control Relay Panel Equipment

E-16 and E-17
OE-6 and OE-7
CO-11 and CO-22
O-11, O-22, O-33 and O-44
*G-1, G-11 and G-2 of 73,000-volt rating and above

\*For the present, the G line of oil circuit-breakers will use the type 30-C control relay and a trip-free relay combination in place of the type S.

List of Air Circuit-Breakers Requiring Type 20-C Control Relays

Type of Air Circuit-Breaker	Description
CA	All sizes and pole combinations having single solenoids
CA and CD	Solenoid-operated field switches
CL	600 amperes and above

PRICES

Style number and list price include equipment complete as described.

Type	Maximum Volts	Intermittent Rating Amperes	Current Taken by Relay Coil Amperes	Style No.	List Price
20-C	125	75	.28	204780	\$25 00
20-C	250	40	.14	204781	28 00
30-C	125	150	.27	309737	48 00
30-C	250	75	.14	309738	51 00
S-1	125	150	.27	375083	70 00
S-1	250	75	.14	375084	75 00
S-2	125	150	.27	375085	110 00
S-2	250	75	.14	375086	115 00

Order by Style Number

## WIRE AND CABLE

In selecting the cable for electrical installations, consideration must be given to the numerous characteristics of the service such as voltage, current frequency, temperature, and the prevalence of water, moisture, oil, acids, or corrosive gases. It is apparent that a great variety of cable designs will be required to cover the possible combinations of the imposed conditions. It is not advisable to list many of these wires and cables since the use of some is so limited. In the following pages wires and cables which will meet the requirements of the majority of installations are listed and described. For other requirements special quotations will be furnished upon receipt of the necessary information. For convenience and accuracy in ordering cable the form shown on page 413 should be used.

The description of each class of wire or cable includes a reference to the specification number. A file of these specifications is maintained in each Westinghouse district office so that the detail characteristics of the conductor in question may be determined.

**Installation Supports**—Where cables are carried on ceilings, suitable supports should be provided to keep them in position. Such supports are listed in section 2-B, Switchboard Details, of this catalogue. Due consideration should be given to the stresses imposed under short-circuit conditions.

Where cables are installed in long vertical runs, they should be supported every ten feet. Where this is not practicable, it is sometimes necessary to fasten supporting clamps to the bare cables and properly insulate the clamps. This method of supporting is especially advisable where the copper conductor is very heavy as it greatly lessens the chance of the conductors slipping through the insulation.

**Taps and Splices**—Taps and splices should usually be made in accordance with the recommendations of the cable manufacturers. Fittings of the kind listed in Section 41-C "Frankel Solderless Connectors" are often useful. Insulating tapes are listed in Section 41-E. Soldering materials are listed in Section 5-B.

**End Bells**—Where needed both end bells and the compound for filling them should be purchased from a reliable cable manufacturer.

**Cable in Ducts and Conduit**—Ducts and conduits should be installed of sufficient size so that the insulation will not be injured as the cable is drawn into them. At the bends, elbows of ample radius should be provided or junction boxes should be used to avoid catching and stripping the insulation. Detailed information for the installation of cables in ducts and the apparatus to carry on the work effectively can be obtained from reputable cable manufacturers.

### RECOMMENDATIONS FOR THE APPLICATION OF CABLES FOR INDOOR USE

#### When Not Used As Part of Apparatus

**Three-Conductor Cables**—For three-phase generator leads where the current is small enough to permit the use of standard three-conductor cables, these are to be preferred to three single-conductor cables. It is not practical to make 3-conductor cable larger than 500,000 circular mils, therefore, single conductor cables in parallel are recommended for larger capacities.

**Single-Conductor Cables**—When single-conductor cables are used on alternating-current circuits in metal conduits, all of the phases of the circuit must be installed within the same metal conduit.

**Heavy Currents**—All cables carrying heavy currents must be rigidly supported to prevent the cables from being displaced by a severe short circuit. If surges are likely to occur, this should be taken into consideration in selecting a cable to withstand the required voltage. For heavy capacities requiring cables in parallel see page 407.

**Mounting on Panels**—Small wiring for transformers, instruments, etc., may be cleated directly upon slate panels for circuits of not over 600 volts, and upon marble panels for circuits of not over 2500 volts, if suitable creepage distance is provided be-

tween conductors and ground. For small multiple conductor cables, see page 407.

**Flameproof Covering**—Flameproof covering does not provide much insulation and therefore should be treated as a conductor and stripped back sufficiently to afford ample creepage distance. When the cable is in such short lengths that it would be necessary to strip off nearly all of the flameproof braid, cables with weatherproof braid may be used.

**End Bells**—End bells must be used on circuits of over 2500 volts for lead covered cables, and should preferably be furnished on circuits of over 750 volts.

**Selection of Cables**—In selecting cables for a required application, the following information will be necessary:

1. Class of service as determined from classification list given below.
2. Working voltage.
3. Amperes carrying capacity or circular mils.
4. Flexibility—whether solid, stiff, or flexible.

#### Classification of Service

Each class of service is given a letter for convenience which will be used for reference.



WIRE AND CABLE—Continued

- (a) Cables located under water.  
In wet ducts.  
In ducts or metal conduits liable to be damp on account of condensation of moisture or other causes.  
Open wiring in damp places.
- (b) Cables in dry ducts or fireproof enclosures where conditions are such that they will never be damp.
- (c) Cables for open wiring in dry places. (Not enclosed in compartments).
- (d) Cables for open wiring in hot places, either bunched together or separated. Used where rubber, varnished cambric or paper insulation would get too hot.  
(Maximum temperature for rubber is 60° Centigrade; for varnished cambric, 75° Centigrade; and for paper, 85° Centigrade. Class (d) cables

cannot be in contact bunched together where the voltage exceeds 75.)

- (e) Cables for heavy capacities, open or in compartments and on insulating supports, being further isolated by guards, barriers or elevation, so that insulation on the conductor may be dispensed with.

Cables fulfilling the requirements of 1, 2, 3 and 4 above, can usually be selected from the tabulation given on the following pages. The cables listed excepting those indicated are regularly carried in stock at East Pittsburgh.

After the above information has been obtained, recommendation as to standard specification on which to order the cable can be obtained from the table "Application Data and Standard Specifications."

CABLES AND INSULATED WIRES—INDEX TO SPECIFICATIONS  
GENERAL POWER CABLES

Max. Service Voltage	Insulation	SOLID WIRES		WEATHERPROOF		SINGLE CONDUCTOR CABLES		W. P. Extra Flex. Spec.**	Lead Cov. Spec.
		W. P. Spec.	F. P. Spec.	Stiff Spec.	Flex. Spec.	Stiff Spec.	Flex. Spec.		
600	Rubber	1501	2282	2753	1504	2465*	2466*	1450	1548
600	Rubber		2474‡		1493†			1661‡	
1000	V. C.	2496†		2579					
2500	Rubber	1446	2449*	1971	1447	2574*		1972‡	1443
3000	V. C.			2116	2580				
4000	Paper								1445
7000	Rubber				1440	2582*			2587
7000	V. C.		2573	2572	2581				
7000	Paper								2588
12000	V. C.	1569		1569					1447
13000	Rubber								1444
27000	V. C.	1568							

All wires and cables have one braid unless otherwise specified.  
Rubber insulated wires and cables with one braid also have a rubber filled tape under the braid for all sizes over 16,600 c.m. unless otherwise specified.

\*Tape on all sizes.  
†Thin rubber insulation, not National Electrical Code Standard.  
‡Oil proof braid.  
§30 per cent Hevea rubber.  
\*\*3 braids.

MULTIPLE-CONDUCTOR CABLES

Number of Cond.	Class of Service	Service Voltage	RUBBER INSULATION			Lead Cov. Spec.	P.I.L.C. Spec.
			Untreated Braid Spec.	W. P. Braid Spec.	F. P. Braid Spec.		
2	Fan Motors	300	1616				
2	Fan Motors	300	2037				
2	Auxiliary Circuits	600			2463	1548	
2 to 30	Car Cables	600			2175		
3	Fan Motors	300	1576				
3	Auxiliary Circuits	600			2463	1548	
3	Power Circuits	600				1535	1536
3	Power Circuits	3500				1537	
3	Power Circuits	4000					1538
3	Power Circuits	7000				2589	2590
3	Power Circuits	13000				1539	1540
4	Auxiliary Circuits	600			2463	1548	
5	Auxiliary Circuits	600				1548	
5	Jumper Cable	{ 600 } 2500			2469		
6	Auxiliary Circuits	600			2463	1548	
7	Auxiliary Circuits	600				1548	
7	Car Cable	600			2584		
7	Jumper Cable	600			2583		
9	Car Cable	600			2584		
9	Jumper Cable	600			2583		
12	Car Cable	600			2584		
12	Jumper Cable	600			2583		
13	Car Cable	600			2584		
13	Jumper Cable	600			2583		
13	Jumper Cable	{ 600 } 2500			2485		
19	Jumper Cable	600			2583		

WIRE AND CABLE—Continued

CABLES IN MULTIPLE

Where more than 1,000,000 c. m. capacity is required, arrange cables in multiple as follows:

CABLES		N. E. CODE RATING		CABLES		N. E. CODE RATING	
Number	Circular Mills	R. I. Amperes	V. C. Amperes	Number	Circular Mills	R. I. Amperes	V. C. Amperes
2	500,000	651 to 800	781 to 960	4	800,000	1951 to 2200	2341 to 2640
2	600,000	801 to 900	961 to 1080	4	1,000,000	2201 to 2600	2641 to 3120
2	800,000	901 to 1100	1081 to 1320	5	1,000,000	2601 to 3250	3121 to 3900
2	1,000,000	1101 to 1300	1321 to 1560	6	1,000,000	3251 to 3900	3901 to 4680
3	800,000	1301 to 1650	1561 to 1980	8	1,000,000	3901 to 5200	4681 to 6240
3	1,000,000	1651 to 1950	1981 to 2340	9	1,000,000	5201 to 5850	6241 to 7020
				12	1,000,000	5851 to 7800	7021 to 9360

APPLICATION DATA AND STANDARD SPECIFICATIONS\*\*

Voltage	Class of Service	Kind	CONDUCTORS RECOMMENDED			
			SINGLE COND. Flexible Spec.	Stiff Spec.	THREE COND. Stiff Spec.	SINGLE COND. Solid Spec.
0 to 600	(a)	R. I. L. C.	↑	*	1535†	*
		V. C. L. C.	↑	*	*	*
		P. I. L. C.	↑	*	*	*
		R. I. W. P.	1504 (3316†)	2753†	*	1501
		V. C. W. P.	*	2579	*	*
601 to 2500	(b)	R. I. F. P.	2466 (2984†)	2465 (3317†)	*	2282
		V. C. F. P.	*	*	*	*
		Slow Burning	*	*	↓	1531
		Bare	1487	*	↓	1596
		2501 to 7000	(a)	R. I. L. C.	↑	1443†
V. C. L. C.	↑			*	3091†	*
P. I. L. C.	↑			*	*	*
R. I. W. P.	1447			1971	*	1446
V. C. W. P.	2580			2116	*	*
7001 to 11,000	(c)	R. I. F. P.	*	2574†	*	2449
		V. C. F. P.	*	*	*	*
		Not Required			↓	
		Bare	1487	*	↓	1596
		11,001 to 13,200	(a)	R. I. L. C.	↑	2587†
V. C. L. C.	↑			*	3092†	*
P. I. L. C.	↑			*	2590†	*
R. I. W. P.	1440			2588†	*	*
V. C. W. P.	2581			2582†	*	*
13,201 to 22,000	(b)	R. I. F. P.	*	2572	*	*
		V. C. F. P.	*	*	*	2573
		Not Required			↓	
		Bare	1487	*	↓	1596
		22,001 to 27,000	(a)	R. I. L. C.	↑	*
V. C. L. C.	↑			*	*	*
P. I. L. C.	↑			*	*	*
R. I. W. P.	*			*	*	*
V. C. W. P.	*			*	*	*
27,001 to 31,200	(b)	R. I. F. P.	*	*	*	*
		V. C. F. P.	*	*	*	*
		Not Required			↓	
		Bare	1487	*	↓	1596
		31,201 to 39,000	(a)	R. I. L. C.	↑	1444†
V. C. L. C.	↑			*	3093†	*
P. I. L. C.	↑			*	*	*
R. I. W. P.	*			*	*	*
V. C. W. P.	*			1569	*	1569
39,001 to 46,800	(c)	R. I. F. P.	*	*	*	*
		V. C. F. P.	*	*	*	*
		Not Required			↓	
		Bare	1487	*	↓	1596
		46,801 to 54,600	(a)	R. I. L. C.	↑	*
V. C. L. C.	↑			*	*	*
P. I. L. C.	↑			*	*	*
R. I. W. P.	*			*	*	*
V. C. W. P.	*			*	*	*
54,601 to 62,400	(b)	R. I. F. P.	*	*	*	*
		V. C. F. P.	*	*	*	*
		Not Required			↓	
		Bare	1487	*	↓	1596
		62,401 to 70,200	(a)	R. I. L. C.	↑	*
V. C. L. C.	↑			*	*	*
P. I. L. C.	↑			*	*	*
R. I. W. P.	*			*	*	*
V. C. W. P.	*			*	*	1568
70,201 to 78,000	(c)	R. I. F. P.	*	*	*	*
		V. C. F. P.	*	*	*	*
		Not Required			↓	
		Bare	1487	*	↓	1596

(Continued on next page)





WIRE AND CABLE—Continued

Stranding	Circular Mils	DIAMETER INCHES		Amps. N. E. Code Rating	Weight in Lbs. per 1000 ft.	Stranding	Circular Mils	DIAMETER INCHES		Amps. N. E. Code Rating	Weight in Lbs. per 1000 ft.
		Bare	Max.					Rate	Max.		
<b>No. 2572; V. C. W. P. Cable, Stiff</b>											
7000 Volts											
7-.040	11,000	.12	.73	30	210						
<b>No. 2573; V. C. F. P. Wire</b>											
7000 Volts											
.102	10,400	...	.74	30	200						
.162	26,200	...	.81	60	280						
.258	66,000	...	.91	110	450						
.365	133,000	...	1.03	180	720						
.460	212,000	...	1.16	270	1000						

**No. 1612; R. I. V. C. & W. P. Cable (Grounded Service for Locomotive Wiring)**

11,000 Volts					
19-.064	78,000	.32	1.48	100	1180

**No. 1569; C. W. P. Wire and Cable**

12,000 Volts

.204	41,600	...	1.12	85	520
19-.072	98,000	.36	1.29	150	780
259-.032	270,000	.67	1.62	305	1490

**No. 1568; V. C. W. P. Wire and Cable**

27,000 Volts

.325	106,000	...	1.78	150	1380
------	---------	-----	------	-----	------

**No. 1487; Bare C. Cable, Stranded, Stiff or Flex.**

10-.0100	1,000	.040	...	...	3
16-.0100	1,600	.050	...	...	5
19-.0142	3,800	.071	...	...	12
19-.0179	6,100	.090	...	...	19
49-.0285	15,000	.14	...	...	47
49-.0226	25,000	.20	...	...	75
49-.0254	32,000	.23	...	...	95
61-.0285	50,000	.26	...	...	150
133-.0254	86,000	.38	...	...	260
19-.0720	98,000	.36	...	...	300
259-.0201	105,000	.42	...	...	320
37-.0570	120,000	.40	...	...	370
61-.0510	160,000	.46	...	...	480
259-.0254	170,000	.53	...	...	520
61-.0570	200,000	.51	...	...	610
61-.0640	250,000	.58	...	...	760
427-.0285	350,000	.77	...	...	1060

Ex. Des.: 10 <sup>in.</sup> of 49 <sup>in.</sup>-.0226 C. cable 1487.

**No. 1552; Flat Braided Bare C. Cable**

384-.005	9,600	.56	...	...	...
912-.005	23,000	.81	...	...	...
240-.010	24,000	.50	wide	...	...
480-.010	48,000	.75	...	...	...
768-.010	77,000	1.06	...	...	...

Ex. Des.: 8 <sup>in.</sup> of 384 <sup>in.</sup>-.0050 C. cable 1552.

**No. 1635; Bare C. Cable, Extremely Flex.**

150-.002	600	.034	...	...	1.8
280-.002	1,100	.043	...	...	3.4

Ex. Des.: 9 <sup>in.</sup> of 150 <sup>in.</sup>-.0020 C. cable 1635.

**No. 2031; Triple B. C. Cable, Flex.**

16-.0100	1,600	.050	.16	...	...
41-.0100	4,100	.080	.18	...	...
19-.0179	6,100	.090	.20	...	...
19-.0226	9,700	.11	.22	...	...

**No. 2054; Bare C. Cable, Extra Flex.**

259-.005	6,500	.11	...	...	20
525-.005	13,000	.16	...	...	40
910-.005	23,000	.20	...	...	70

Ex. Des.: 8 <sup>in.</sup> of 259 <sup>in.</sup>-.0050 C. cable 2054.

**No. 2602; Double B. C. F. P. Cable**

**Extra Flex.**

28-.0063	1,100	.040	.090	2	6.3
----------	-------	------	------	---	-----

**No. 3002; B. C. Cable—Flex.**

(Cotton yarn wrapped and braided)

15-.0050	380	.023	.062	...	1.4
----------	-----	------	------	-----	-----

Ex. Des.: 9 <sup>in.</sup> of 1.9 <sup>in.</sup>-.0226 cable 1440. 22 <sup>in.</sup> of <sup>in.</sup>-.051 dia. wire 1446.

These standard example designations do not apply where an example designation is shown at the bottom of the group.

**CABLES FOR AUXILIARY CIRCUITS ON ELECTRICALLY-OPERATED SWITCHBOARDS**

As the instruments and control switches for electrically-operated switchboards are usually located some distance from the meter transformers, circuit-breakers, rheostats and other accessories, it is necessary to use connecting leads of varying lengths. For this purpose, multiple-conductor cables, as listed herein, are used.

**Size of Cable Required**—The sizes of conductors generally used, where lengths do not exceed 500 feet, are as follows:

For current transformer circuits, each lead equivalent to 19,500 circular mils and for very short runs 10,000 circular mils. For potential transformer circuits, each lead equivalent to 10,000 or 6,000 circular mils.

For small solenoid-operated circuit-breakers, closing-coil leads equivalent to 19,500 circular mils; tripping-coil and indicator leads equivalent to 6,000 circular mils; return circuit being same size as closing-coil lead, either in same cable or separate.

For large oil circuit-breakers on control circuits of 125 volts or lower, it is sometimes considered advisable to use a heavier closing lead. In every case it is advisable to carefully check the drop in the closing circuit to insure proper operation of the breaker, as in some cases very heavy leads will be required. When a relay switch is used, the lead from the control switch is only large enough for the current in the relay switch, for which purpose 6,000-circular mil cable is usually adequate.

WIRE AND CABLE—Continued

For engine governor control or electrically-operated rheostat control, each lead should be equivalent to 10,000 or 6,000 circular mils; three, four or six leads being used, as required.

**Specifications**—The cables listed in the following pages are manufactured according to Westinghouse Electric & Manufacturing Company specifications, and are particularly adapted to the diverse requirements of switchboard service.

**Insulation**—Each individual conductor is insulated for 600-volt service and is covered with braid with an identifying color. The insulated conductors are assembled and covered with a layer of tape and an outer braided covering or lead sheath. The outer covering of the cable selected depends upon the nature of the installation.

**Colors of Leads**—The colors used in identifying the individual conductors are as follows: First, Black; second, White; third, Red; fourth, Green; fifth, Yellow; sixth, Blue; seventh, Yellow and Green. For example, a four-conductor cable requires the use of the first four colors: black, white, red, and green.

When conductors of different sizes are used in a multiple-conductor cable, the sequence of colors given above is followed in the order of the capacities the largest conductors having a black braid, the next largest a white braid, etc.

**Prices**—Owing to the wide fluctuations in the market price of the materials used in the manufacture of the cables, **prices will be quoted only upon application.**

**RUBBER-INSULATED BRAID-COVERED BLACK FLAME-PROOF MULTIPLE-CONDUCTOR CABLES FOR AUXILIARY CIRCUITS**

**Specification 2463**

Number of Conductors	Stranding of Each Conductor	Circular Mils	DIAMETER, INCHES		Approx. Wt. Lbs. Per 1000 ft.
			Bare Copper	Over Outer Braid Maximum	
2	19 of .0179"	6000	.0895	.57	150
2*	19 of .0226"	10000	.113	.62	195
2	19 of .032"	19500	.160	.78	325
3	19 of .0179"	6000	.0895	.61	190
3*	19 of .0226"	10000	.113	.66	225
3*	19 of .032"	19500	.160	.84	430
3	{ One 19 of .032" Two 19 of .0179"	{ 19500 6000	{ .160 .0895	.70	230
3	{ One 37 of .0359" Two 19 of .0179"	{ 47500 6000	{ .251 .0895		
4	19 of .0179"	6000	.0895	.66	210
4*	19 of .0226"	10000	.113	.72	300
4*	19 of .032"	19500	.160	.92	540
4	{ One 19 of .032" Three 19 of .0179"	{ 19500 6000	{ .160 .0895	.76	375
4*	{ Two 19 of .032" Two 19 of .0179"	{ 19500 6000	{ .160 .0895		
5	19 of .0179"	6000	.0895	.75	260
5	19 of .0226"	10000	.113	.82	350
5	{ Two 19 of .032" Three 19 of .0179"	{ 19500 6000	{ .160 .0895	.86	450
6	19 of .0179"	6000	.0895		
6*	19 of .0226"	10000	.113	.88	500
6*	19 of .032"	19500	.160	1.12	760
7	19 of .0179"	6000	.0895	.80	420
7	19 of .0226"	10000	.113	.88	540

\*These items are regularly carried in stock at East Pittsburgh.

**RUBBER-INSULATED LEAD-COVERED SINGLE AND MULTIPLE-CONDUCTOR CABLES FOR AUXILIARY CIRCUITS**

**Specification 1548**

Number of Conductors	Stranding of Each Conductor	Circular Mils	DIAMETER, INCHES		Approx. Wt. Lbs. per 1000 ft.
			Bare Copper	Over Lead Maximum	
1	19 of .0226"	10000	.113	.37	390
1	19 of .032"	19500	.160	.45	530
1	37 of .0285"	30000	.200	.49	600
1	37 of .0359"	47500	.251	.55	720
2	19 of .0179"	6000	.0895	.65	600
2	19 of .0226"	10000	.113	.69	735
2	19 of .032"	19500	.160	.88	930
3	19 of .0179"	6000	.0895	.68	715
3	19 of .0226"	10000	.113	.73	805
3	19 of .032"	19500	.160	.94	1180
4	19 of .0179"	6000	.0895	.73	800
4	19 of .0226"	10000	.113	.79	915
4	19 of .032"	19500	.160	1.02	1400
4	{ One 19 of .032" Three 19 of .0179"	{ 19500 6000	{ .160 .0895	.86	1025

(Continued on next page)

WIRE AND CABLE—Continued

LEAD-COVERED CONDUCTOR CABLES—Continued

Number of Conductors	Stranding of Each Conductor	Circular Mils	DIAMETER, INCHES—		Approx. Wt. Lbs. per 1000 ft.
			Bare Copper	Over Lead Maximum	
4	Two 19 of .032"	19500	.160	.94	1200
	Two 19 of .0179"	6000	.0895		
5	19 of .0179"	6000	.0895	.82	1200
5	19 of .0226"	10000	.113	.92	1300
5	Two 19 of .032"	19500	.160	.90	1400
	Three 19 of .0179"	6000	.0895		
6	19 of .0179"	6000	.0895	.90	1040
6	19 of .0226"	10000	.113	1.10	1200
6	19 of .032"	19500	.160	1.25	1700
7	19 of .0179"	6000	.0895	.90	1075
7	19 of .0226"	10000	.113	1.10	1200

The cables tabulated under specification 1548 are not carried in East Pittsburgh stock. Delivery will be facilitated by ordering sizes corresponding to those stock sizes in the preceding list of braid-covered cables as they are already available and may be provided with a lead covering.

Westinghouse Electric & Manufacturing Company

INFORMATION REQUIRED IN ORDERING WIRE AND CABLE

Date.....19..... G. O. No.....  
 Customer..... Neg. No.....  
 Destination.....

If the required cable cannot be selected from the list of standard cables shown on the previous pages, this form should be filled out in detail for each different size and application, and recommendation obtained from the Works at East Pittsburgh or from responsible cable company as to the proper cable to specify.

REQUIREMENTS:

1. Class of Service.....(Insert proper letter selected from list below).
2. Give circuit designation (as generator, feeder, etc.).....with Kv-a or ampere ratings....., Normal Rating..... Maximum rating.....
3. Service Voltage A-C....., D-C..... Cycles.....
4. Solid.....Stiff.....Flexible.....
5. Number of conductors per cable.....
6. Specify any armour or outer covering specially required.....
- \*\*7. Specify kind of insulation (Rubber, Varnished Cambric, or Paper)..... Will substitution be allowed.....
8. What is the maximum permissible overall diameter?.....
- †9. What is total length required?.....
10. If not needed in single length give cutting lengths.....
11. What is latest permissible delivery date?.....
12. What department at Works is interested?.....

REMARKS:.....  
 .....  
 .....

CLASSIFICATION OF SERVICE:

- (a) Cables located under water.  
 In wet ducts.  
 In ducts or metal conduits liable to be damp on account of condensation of moisture or other causes.  
 Open wiring in damp places.
- (b) Cables in dry ducts or fireproof enclosures where conditions are such that they will never be damp.
- (c) Cables for open wiring in dry places. (Not enclosed in compartments).
- (d) Cables for open wiring in hot places, either bunched together or separated. Used where rubber or varnished cambric or paper insulation would get too hot.  
 (Maximum temperature for rubber is 60°C.; for varnished cambric, 75°C.; and for paper, 85°C. Class (d) cables can not be in contact bunched together where the voltage exceeds 75.)
- (e) Cables for heavy capacities, open or in compartments and on insulating supports, being further isolated by guards, barriers or by elevation, so that insulation on the conductor may be dispensed with.

\*\*See notes at top of page 409.

†The price will necessarily be high when ordered in small quantities, with possibility of long delay in delivery. In order to obtain minimum price, it is necessary to order at least 1000 ft. of cable.

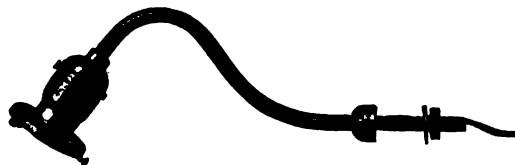
District Office.....  
 Salesman.....

Modification of Form 8660

## LAMP SOCKETS, SHADES AND BRACKETS



METAL SHADE STYLE NO. 27659



LAMP BRACKET, STYLE NO. 170664 (INCLUDES SOCKET AND SHADE HOLDER, STYLE NO. 144265)



PORCELAIN BASE SOCKET, STYLE NO. 9428



SWITCHBOARD SOCKET, STYLE NO. 238396

The brackets as listed and illustrated here are of the type furnished when required on standard panels for illuminating meters on the front of panels.

These brackets furnished in our standard black marine finish are of a neat and pleasing appearance, conforming to the finish of the board. They require only one hole in the switchboard panel, since they are held in place by the clamping action of the two nuts, one in front, the other in rear of the panel. The sockets used are designed for Edison base lamps.

The shade holders, supplied only as part of the socket and shade holder, fit 2 1/4-inch shades.

The shades are designed so that the light is reflected downward, directing the illumination to the point desired.

The lamp sockets are of the National Electrical Code standard design and, except the porcelain base sockets, have our standard switchboard black marine finish.

Porcelain base socket Style No. 9428 is intended for mounting on the rear of the board only.

Keyless socket and shade holder (Style No. 144265) are used in the assembly of our standard lamp brackets.

Switchboard socket Style No. 238396 is intended for mounting on the front of board, and is arranged for rear connection. The two rear connection studs also hold the socket on the board, thus requiring only two holes to be drilled. The case is of moulded insulation, matching in appearance the standard black marine finish. This case can be easily fastened over the socket from the front of the board after all connections are made. The socket was especially developed for switchboard mounting, and is undoubtedly the most convenient ever produced for that purpose, and is especially neat in appearance.

Style No.	Description	FINISH		Thickness of Panel, Inches	List Price
		Outside	Inside		
170664	Lamp Bracket*	Black Marine	.....	1 1/4 to 2	\$5 00
215580	Lamp Bracket Complete†	Black Marine	.....	1 1/2 to 2	8 50
9428	Porcelain Base Wall Socket	.....	.....	.....	80
144265	Keyless Bracket Socket and Shade Holder	Black Marine	.....	.....	1 85
238396	Switchboard Socket	Black Marine	.....	1 1/4 to 2	1 85
27659	Metal Shade	Black Marine	White	.....	2 50
142080	Glass Shade	Green	White	.....	3 00

\*Style number and list price include bracket, keyless socket, shade holder and lamp cord.  
 †Style number and list price include bracket, keyless socket, shade holder, lamp cord, metal shade and one 16-candle-power 110-volt incandescent lamp.

Order by Style Number



## SWITCHBOARD FRAMES

Westinghouse switchboard frames are of two general types: one made from structural steel angle and the other made from iron pipe. Certain changes have been made in the standard frames since the issue of the previous catalogues. Therefore frames for addition to boards employing previous designs of frames cannot be ordered by the style numbers in this catalogue. Instead, give type of frame and the approximate date of purchase of the older frame.

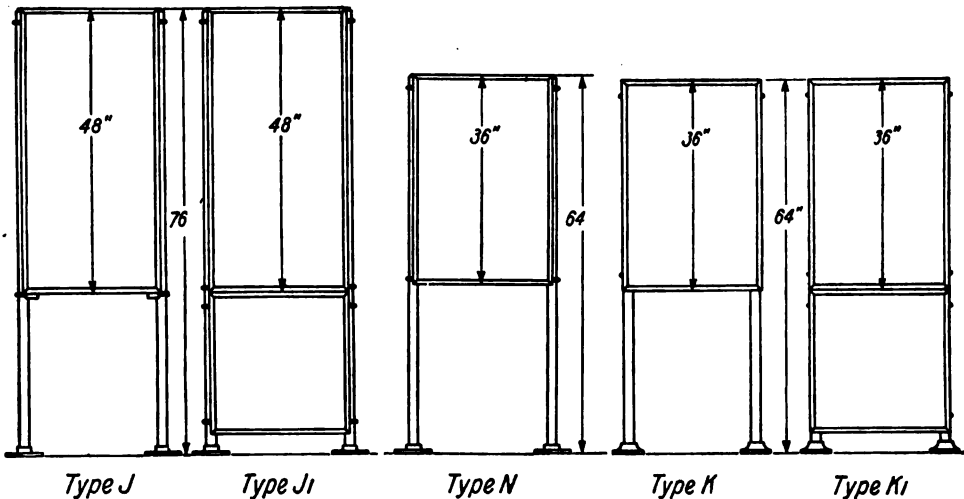
The application of the tubular type of frames, in general, is limited to light panels and small switch-

boards. The angle types are better suited for heavy panels and large switchboards. Angle frames are cheaper and more convenient than tubular for shipping and erecting, as each panel may be shipped completely wired without dismantling.

Frames should be ordered according to the instructions given under the different types.

The descriptions are given looking at the front of the switchboard.

Panel mounting bolts are included in the style numbers.



NOTE:—The type does not specify width, thickness, or material of slabs.

### TYPES J, J-1 AND N FRAMES

The types J, J-1 and N frames consist of  $1\frac{1}{4}$ -inch wrought-iron pipe uprights resting in floor flanges and with the necessary panel mounting brackets, top-iron brackets, and a flat top-iron, which is optional, as listed on next page. The top-iron when used with switchboard frames of more than one panel forms a continuous tie across the switchboard, provides a good alignment for the various panels, and also renders bracing each panel to the wall unnecessary, so that fewer wall braces are required. Wall and floor braces are not regularly supplied with these frames. Channel bases are supplied with multi-panel switchboards having sub-panels. When used, the channel base increases the over-all height by 2 inches.

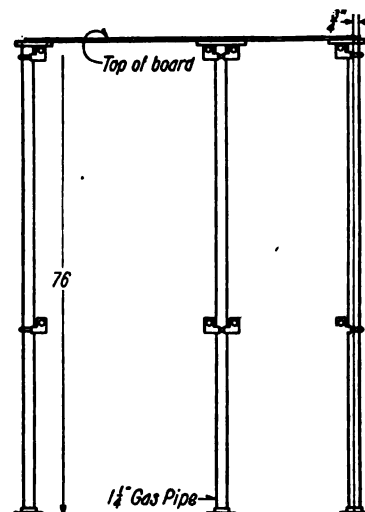
These frames are intended for the lighter line of panels and switchboards. They are designed particularly for individual panel mounting about the station, and for multi-panel switchboards used with smaller equipments.

The type J frame is designed for a one-section switchboard panel 48 inches high, supported 28 inches above the floor. This space will permit the addition of a sub-panel not exceeding 25 inches in height.

The type J-1 frame is designed for a two-section switchboard panel; the upper slab is 48 inches, and the lower slab 25 inches in height.

As listed on next page, types J and J-1 frames, when used for single panels only, will be furnished without top-iron brackets.

The type N frame is designed for a one-section switchboard panel 36 inches high of more than 1 inch in thickness, supported 28 inches above the



TYPE J FRAME DETAILS

SWITCHBOARD FRAMES—Continued

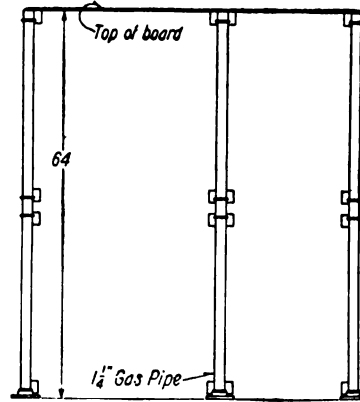
Prices—Types J, J-1 and N Frames

floor. This space will permit the addition of a sub-panel 25 inches high. The type N frame is regularly furnished without top-iron brackets.

In ordering complete frames, specify the type-letter, quantity and style numbers of the frame uprights required, and in addition for switchboards of more than one panel, specify the number of panels constituting the switchboard, width, and consecutive order of panels. Detail parts ordered separately should be specified by style number.

List price and style numbers of uprights include 1 1/4-inch pipe, floor flange, panel brackets, and panel mounting bolts for 1 1/2-inch thick panel, and also top-iron brackets with frames for multi-panel use only. They do not include floor or wall braces. Two right or left-hand uprights are required for each separate switchboard, and as many intermediate uprights as there are panels in the switchboard, less one. Approximate net weight per panel 40 pounds.

For wall or floor braces and description of panel-mounting brackets, see pages of this catalogue on "Indoor Bus Supports and Switchboard Details."



TYPE N FRAME DETAILS

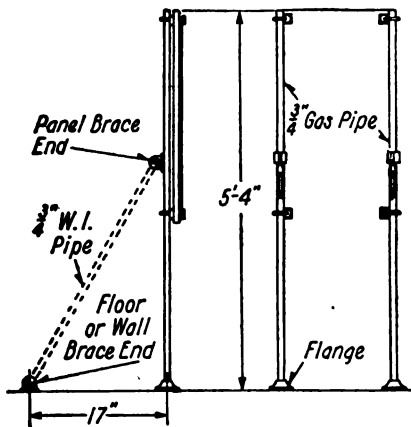
Detail Parts

Types J, J-1 and N Frames

Type of Frame	Description	INTERMEDIATE UPRIGHT Style No.	UPRIGHT List Price	RIGHT OR LEFT-HAND UPRIGHT Style No.	List Price
J	For one panel-swbd.			380910	\$7 00
J-1	For more than one-panel swbd.	380912	\$8 50	380911	8 00
J-1	For one-panel swbd.			380913	8 50
J-1	For more than one-panel swbd.	380915	10 50	380914	9 50
N	For one-panel swbd.			380916	6 50

Top-iron, (optional—state clearly if wanted) length equal to length of board, for frames types J and J-1, list price, \$1.10 per foot. Maximum length of top-iron in one piece, 12 feet. Joints in top-iron to be made at center line of pipe, without lap. Channel base, length equal to length of board, \$5.50 per foot.

TYPES K AND K-1 FRAMES



TYPE K FRAME

Types K and K-1 frames are ordinarily used for individual panels for light mounting. On special order they can be obtained suitably arranged for a multi-panel switchboard.

The type K frame is designed for a one-section panel, 1 inch in thickness.

The type K-1 frame is designed for a two-section panel, 1 inch in thickness.

Prices

Types K and K-1 Frames

List price and style number of the type K frames include the frame complete with panel mounting, brackets and mounting bolts, but without wall or floor braces. Approximate net weight complete frame—30 pounds.

Style No.	Type Frame	List Price
212029	K	\$ 9 75
212030	K-1	12 25

Wall and Floor Braces

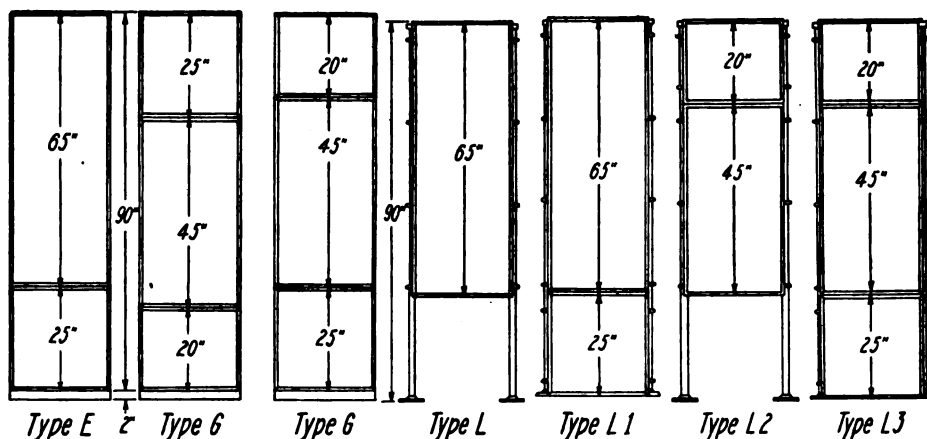
Style No.	Description	List Price Each
261579	Wall Braces or Floor Braces, complete (2 required per panel)	\$4 75
216515	Panel End of brace (2 required per panel)	2 00
226473	Floor or Wall End (2 required per panel)	1 50

Construction—The type K frame consists of two 3/4-inch iron pipe uprights resting in floor flanges, and complete with panel mounting brackets. The total height of the frame is 64 inches.

Order by Style Number,

SWITCHBOARD FRAMES—Continued

TYPES E AND G FRAMES



NOTE—The type does not cover width, thickness, or material of slabs.

**Construction**—Types E and G frames consist of a channel base, angle uprights, top-iron, which is optional, and the necessary corner angles. The base and top-iron form a continuous tie across the switchboard, provide a good alignment for the various panels, and render bracing each panel to the wall unnecessary, when the top iron is used. Wall braces are not included.

The type E frame is designed for a two-section switchboard panel; the bottom slab is 25 inches and

the top slab 65 inches in height. The total height of the frame, including the base, is 92 inches.

The type G frame is designed for a three-section switchboard panel. The uprights are so designed that they may be inverted. This permits of an arrangement with a 20-inch high top section and a 25-inch high bottom section or the reverse as shown in the cuts above. The middle section, in either case, is 45 inches in height. The total height of the frame, including the base, is 92 inches.

Prices—Types E and G Frames

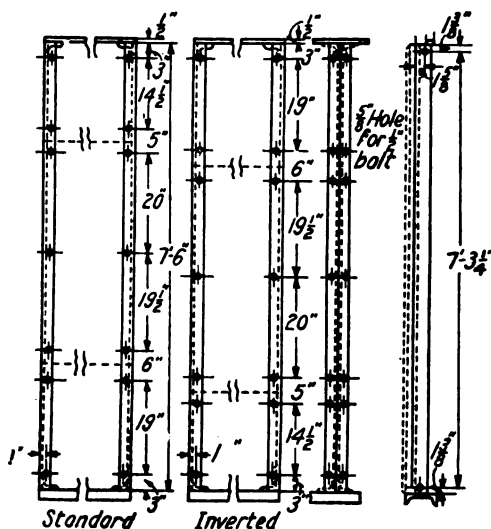
In ordering complete frame, specify type letter, quantity and style number of the frame uprights, number of panels constituting the switchboard, width, and consecutive order of panels. Detail parts ordered separately should be specified by style number.

Style No.	Description	Net Wt. Lbs.	List Price
380922	Type E or G complete right or left-hand upright with corner angles; two required per panel, each	45	\$13 00
	Channel base, length equal to length of board; per foot of switchboard length	8	5 50
	Top-iron, (optional—state clearly if wanted) length equal to length of board; per foot of switchboard length	4	1 10

Length of one section of channel iron or top-iron will not exceed 12 feet. Joints will be made between panels without lap.

Frame style number includes angle-iron side, corner angles, and panel mounting-bolts for 2-inch thick panel. Longer bolts will be supplied on request.

For Wall and Floor Braces, see pages in this catalogue on "Switchboard Details and Indoor Bus-Supports."



TYPES E AND G FRAMES

Order by Style Number

SWITCHBOARD FRAMES—Continued

TYPES L, L-1, L-2, AND L-3 FRAMES

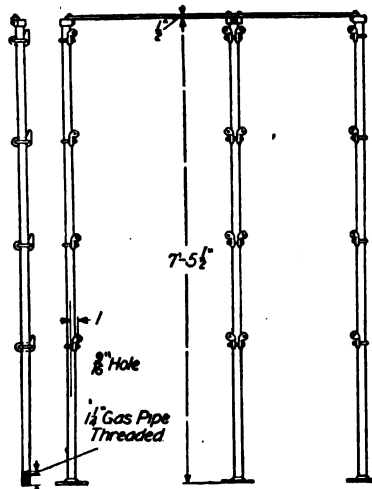
**Construction**—Type L frames consist of 1¼-inch iron pipe uprights resting in floor flanges and with the necessary panel-mounting brackets, panel-mounting bolts for 2-inch thick panel, top-iron brackets, and top-iron, which is optional. The top-iron which is optional, when supplied, forms a continuous tie across the switchboard, provides a good alignment for the various panels, and renders bracing each panel to the wall unnecessary. A channel-iron base is regularly supplied with the type L frame when used in a multi-panel switchboard. The total height of the type L frame is 90 inches without, and 92 inches with, the channel base.

The type L frame is designed for a one-section switchboard panel, 65 inches in height, supported 25 inches above the floor. This space will allow the addition of a standard 25-inch sub-panel.

The type L-1 frame is designed for a two-section switchboard panel. The bottom slab is 25 inches, the top slab 65 inches in height.

The type L-2 frame is designed for a two-section switchboard panel; the lower slab is 45 inches, and the top slab 20 inches in height, the lower slab being supported 25 inches above the floor. This space will permit the addition of a standard 25-inch sub-panel.

The type L-3 frame is designed for a three-section switchboard panel; the bottom slab is 25 inches, the middle section 45 inches, and the top section 20 inches in height.



TYPE L FRAME

Prices—Types L, L-1, L-2, and L-3 Frames

In ordering complete frames, specify type letter, quantity and style number of frame uprights, number of panels constituting the switchboard, width, and consecutive order of panels. Detail parts ordered separately should be specified by style number.

Detail Frame Parts

List price and style number of uprights include a 1¼-inch pipe, floor flange, panel and top-iron brackets, and panel mounting-bolts for 2-inch thick panel. They do not include floor or wall braces. Two right or left-hand uprights are required for each separate switchboard, and as many intermediates as there are panels less one. Approximate net weight per panel—50 pounds.

For wall and floor braces see pages of this catalogue on "Switchboard Details and Indoor Bus Supports."

Type Frame	Style No.	List Price
RIGHT OR LEFT-HAND UPRIGHT		
L	380923	\$10 00
L-1	380925	11 50
L-2	380927	11 00
L-3	380929	12 25
INTERMEDIATE UPRIGHT		
L	380924	10 50
L-1	380926	12 00
L-2	380928	11 50
L-3	380930	13 00

Channel base, length equal to length of board; per foot of switchboard length \$5.50.

Top-iron, length equal to length of board; per foot of switchboard length for frames L, L-1, L-2, L-3, list price, \$1.10, optional—state clearly if wanted.

Maximum length of channel iron or top-iron in one piece is 12 feet. Joints in top-iron to be made at center line of pipe, without lap.

Order by Style Number

## BLANK PANELS DRILLED FOR MOUNTING BOLTS

The line of switchboard panels adopted as standard and listed with style numbers in Catalogue, Section 2-A, "Westinghouse Switchboards," satisfactorily meets the majority of demands for switchboard panels. Conditions arise, however, where it is necessary to supply blank panels to be mounted and assembled at destination, to supply panels for remote control switchboard equipments, or to meet other special requirements. For these purposes the switchboard panels listed and described in the following pages are intended.

Wherever possible, standard switchboards should be ordered, as templates are kept at the Works for drilling these panels and shipment can be made on same in considerably less time than if they require special drilling. The Works is very completely equipped for switchboard manufacture and is thus prepared to furnish a line of material built in a neat and workmanlike manner, such as would not be possible by local workmen with limited equipment and experience in such work. However, when a customer so desires, drilling plans for apparatus to be mounted on the panels will be supplied on application to the nearest district office.

The panels listed herein are made from the best quality of slate or marble of high insulating properties and free from metallic streaks or veins. They are not given style numbers on account of the great number of special orders for this material. The material, height, width, thickness, bevel and finish must be specified with order. Any drilling required must be definitely specified. The front and beveled edges are finished and the back is left plain. Several different finishes are offered. Care should be taken to order standard sizes as listed, as special sizes or special bevells will cause delay.

**Slate** by itself should not be depended upon for insulating live contacts for voltages above 750. For application on higher voltages, insulating bushings are used.

**Marble** should not be depended upon for insulating live contacts where voltage exceeds 3300.

**Polished Blue Vermont Marble**—When specially ordered, shades A, B, C, and D, Blue Vermont marble with face and bevells highly polished can be supplied. This panel material is not regularly carried in stock, and usually has to be obtained from the quarries, with a consequent delay in shipment.

Great care is exercised in matching marble for individual boards in order to see that harmony

in shading and veining is obtained. When a close match with existing panels is desired, the marking and shade to be followed should be indicated by a photograph forwarded with the order.

**White Italian Marble** has a grayish white color with occasional faint dark gray veins running through it. It shows oil stains very plainly and is more expensive than the other marbles. This marble is not kept in stock.

**Plain Slate**—This is unfinished slate with the surface rubbed smooth.

**Black Marine Slate**—This material and finish has been adopted as standard in all cases where voltage limitations of slate are not exceeded.

The color is a dull soft black and can easily be restored if damaged. If the panels are likely to be spotted by oil, they may be given a treatment which will prevent the oil from showing, although it adds a slight luster to the appearance of the panel. This latter finish is known as "Oiled Black Marine."

**Black Enameled Slate**—This finish is a bright glossy black. The enamel will not break or chip off and retains its luster, but will show scratches made on its surface. This finish does not show oil stains.

**Natural Black Slate, Oil Finish**—This is a black slate with an oil finish and is highly desirable where there is any liability of oil coming in contact with the panel, since oil-marks do not show as plainly as on panels not finished in this manner.

**Black Monson Slate** is a variety of natural black slate. On account of the small demand for this material no attempt is made to carry a stock.

The list price includes panel with the finish given and drilled for mounting bolts as per table below.

Black marine finished marble is available for immediate shipment from stock. Shades A, B, C and D marble require from six (6) to eight (8) weeks for shipment. White Italian requires from eight (8) to ten (10) weeks for shipment.

A stock of black marine slate panels is available for immediate shipment. Black enameled slate panels require ten (10) days and natural black slate panels from six (6) to eight (8) weeks.

**When ordering** blank panels, specify material, height, width, thickness and panel number, from table at top of next page.

**Bevel**—Standard panels are provided with a  $\frac{1}{4}$ -inch bevells on all front edges.

BLANK SWITCHBOARD PANELS—Continued

DIMENSIONS

No.	PANEL			DIMENSIONS IN INCHES—FIG. 1					
	Height Inches	Thickness Inches	Number of Holes	A	B	C	D	E	F
1	12	1	2	1	6	6	.....	..	1 1/8
2	12	1	4	1 1/8	1 3/8	1 3/8	.....	..	1 1/8
3	14	1	4	1 1/8	3 1/2	3 1/2	.....	..	1 1/8
4	18	1	4	1 1/8	1 3/8	1 3/8	.....	..	1 1/8
5	24	1	4	1 1/8	6	6	.....	..	1 1/8
6	24	1	4	1 1/8	1 3/8	1 3/8	.....	..	1 1/8
7	28	1	4	1 1/8	3 1/2	3 1/2	.....	..	1 1/8
8	36	1	4	1 1/8	1 3/8	1 3/8	.....	..	1 1/8
9	36	1	4	1 1/8	1 3/8	1 3/8	.....	..	1 1/8
10	25	1 1/4	4	1 3/8	1 3/8	1 3/8	.....	..	1 1/8
11	36	1 1/4	4	1 3/8	1 3/8	1 3/8	.....	..	1 1/8
12	48	1 1/4	4	1 3/8	2	1 3/8	.....	..	1 1/8
13	25	1 1/2	4	1 3/8	1 3/8	1 3/8	.....	..	1 1/8
14	48	1 1/2	4	1 3/8	2	1 3/8	.....	..	1 1/8
15	20	2	4	1 3/8	3	2 1/2	.....	..	1 1/8
16	25	2	4	1 3/8	3	2 1/2	.....	..	1 1/8
17	25	2	4	1 3/8	3	3	.....	..	1 1/8
18	30	2	4	1 3/8	3	2 1/2	.....	..	1 1/8
19	45	2	6	1 3/8	2 1/2	3	20	..	1 1/8
20	65	2	8	1 3/8	3	3	19 1/2	20	1 1/8
21	25	2 1/4	4	1 3/8	3	2 1/2	.....	..	1 1/8
22	30	2 1/4	4	1 3/8	3	2 1/2	.....	..	1 1/8
23	45	2 1/4	6	1 3/8	2 1/2	3	20	..	1 1/8
24	65	2 1/4	8	1 3/8	3	3	19 1/2	20	1 1/8

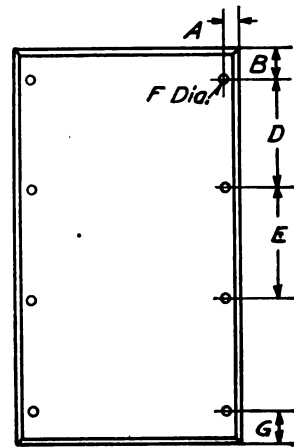


FIG. 1

PRICES

Marble Panels

Height	SIZES IN INCHES			Bevel	LIST PRICES FOR VARIOUS FINISHES—Shades A, B, C		
	Width	Thickness	Black Marine		and D Marble	White Italian	
12	16	1	1/4	1/4	\$ 9 35	\$10 80	\$13 00
18	16	1	1/4	1/4	13 90	18 00	18 90
24	16	1	1/4	1/4	17 70	20 50	24 50
36	16	1	1/4	1/4	27 50	32 00	37 75
36	16	1 1/4	1/4	1/4	29 25	35 00	41 50
36	20	1 1/4	1/4	1/4	35 75	43 00	50 00
36	24	1 1/2	1/4	1/4	48 50	58 00	65 00
28	12	1 1/2	1/4	1/4	20 50	25 00	30 00
28	16	1 1/2	1/4	1/4	27 50	33 00	39 00
28	20	1 1/2	1/4	1/4	32 50	39 00	47 00
28	24	1 1/2	1/4	1/4	38 50	46 50	55 50
28	32	1 1/2	1/4	1/4	50 00	60 00	72 00
48	12	1 1/2	1/4	1/4	35 00	42 00	50 50
48	16	1 1/2	1/4	1/4	47 00	56 50	67 50
48	20	1 1/2	1/4	1/4	55 75	67 50	80 50
48	24	1 1/2	1/4	1/4	66 00	79 50	95 50
48	32	1 1/2	1/4	1/4	85 00	103 00	124 00
20	16	2	1/4	1/4	24 00	28 50	38 50
25	16	2	1/4	1/4	28 75	34 25	45 75
45	16	2	1/4	1/4	50 00	59 75	80 00
65	16	2	1/4	1/4	71 50	85 25	114 00
20	20	2	1/4	1/4	28 75	28 75	45 50
25	20	2	1/4	1/4	35 00	41 75	56 00
30	20	2	1/4	1/4	37 95	45 25	65 50
45	20	2	1/4	1/4	61 50	74 00	98 00
65	20	2	1/4	1/4	85 25	103 00	136 00
20	24	2	1/4	1/4	33 50	39 75	53 50
25	24	2	1/4	1/4	40 50	48 50	65 50
30	24	2	1/4	1/4	47 50	57 00	76 50
45	24	2	1/4	1/4	69 00	85 00	115 00
65	24	2	1/4	1/4	98 00	120 00	160 00
20	32	2	1/4	1/4	43 00	51 50	68 75
25	32	2	1/4	1/4	52 00	62 50	84 00
45	32	2	1/4	1/4	92 00	110 00	148 00
65	32	2	1/4	1/4	134 00	160 00	215 00
20	40	2	1/4	1/4	52 00	62 75	84 00
25	40	2	1/4	1/4	63 75	76 75	107 00
45	40	2	1/4	1/4	120 00	143 00	191 00
65	40	2	1/4	1/4	164 00	197 00	265 00
20	48	2	1/4	1/4	63 75	76 75	103 00
25	48	2	1/4	1/4	77 50	93 00	126 00
45	48	2	1/4	1/4	142 00	170 00	225 00
65	48	2	1/4	1/4	198 00	235 00	315 00

BLANK SWITCHBOARD PANELS—Continued

PRICES  
Slate Panels

Height	SIZES IN INCHES			Bevel	LIST PRICES FOR VARIOUS FINISHES		
	Width	Thickness			Black Marine	Black Enamel	Natural Black
12	16	1		1/4	\$ 7 80	\$11 90	\$ 9 00
12	20	1		1/4	10 00	14 95	11 00
12	32	1		1/4	14 75	22 50	16 50
14	24	1		1/4	12 75		
18	16	1		1/4	11 75	17 60	13 00
24	16	1		1/4	15 00	15 40	16 80
24	20	1		1/4	19 00	30 00	22 95
24	32	1		1/4	28 50	44 25	34 00
28	24	1		1/4	22 00		
36	16	1		1/4	26 00	37 90	30 00
36	16	1 1/4		1/4	28 50	40 50	35 00
36	20	1 1/4		1/4	34 50	49 25	42 50
36	24	1 1/2		1/4	44 00	62 00	53 00
28	12	1 1/2		1/4	17 50	25 00	24 00
28	16	1 1/2		1/4	24 50	34 50	32 50
28	20	1 1/2		1/4	28 50	40 00	38 00
28	24	1 1/2		1/4	37 50	51 00	49 50
28	32	1 1/2		1/4	52 50	66 00	64 00
48	12	1 1/2		1/4	30 00	42 50	40 75
48	16	1 1/2		1/4	42 00	55 00	55 50
48	20	1 1/2		1/4	49 00	69 00	65 00
48	24	1 1/2		1/4	63 00	87 00	85 00
48	32	1 1/2		1/4	90 00	113 00	110 00
20	16	2		1/4	21 00	27 75	27 75
25	16	2		1/4	24 50	32 50	32 75
45	16	2		1/4	44 50	59 50	63 00
65	16	2		1/4	63 00	85 00	90 00
20	20	2		1/4	24 50	32 50	32 75
25	20	2		1/4	31 00	41 00	43 75
30	20	2		1/4	35 75	48 25	51 50
45	20	2		1/4	54 50	73 00	87 00
65	20	2		1/4	78 50	105 00	115 00
20	24	2		1/4	29 00	39 00	41 75
25	24	2		1/4	35 50	42 25	51 25
30	24	2		1/4	41 00	45 50	59 75
45	24	2		1/4	63 50	86 00	90 50
65	24	2		1/4	91 50	124 00	135 00
20	32	2		1/4	37 00	50 50	53 75
25	32	2		1/4	45 50	62 00	65 75
45	32	2		1/4	85 00	115 00	126 00
65	32	2		1/4	130 00	173 00	197 00
20	40	2		1/4	45 50	62 00	65 75
25	40	2		1/4	55 50	76 00	80 00
45	40	2		1/4	118 50	155 00	175 00
65	40	2		1/4	170 00	225 00	260 00
20	48	2		1/4	56 50	76 00	80 00
25	48	2		1/4	71 75	96 50	106 00
45	48	2		1/4	148 50	192 00	225 00
65	48	2		1/4	220 00	285 00	335 00
25	20	2 1/4		1/4 x 3/4	38 00	46 25	60 00
25	24	2 1/4		1/4 x 3/4	41 00	53 50	70 00
45	20	2 1/4		1/4 x 3/4	62 75	81 50	105 00
45	24	2 1/4		1/4 x 3/4	73 75	96 00	125 00

## GRILLEWORK PANELS FOR SWITCHBOARDS

The use of grillework panels for the proper screening off of switchboards and switchboard parts from the remainder of the station is strongly recommended.

Screening of the entire board limits admittance to the rear to authorized persons, besides adding to the appearance of the whole installation; screening of high-voltage live parts, such as oil circuit-breakers and their connections along aisles and runways, is an added precaution to the safety of the operators; screening of bus-bars and the tops of switchboards adds to the continuity of the service. These three

$\frac{7}{8}$ -inch wide with 1-inch square opening; and third, No. 16 gauge flat wire  $\frac{1}{2}$ -inch wide with  $\frac{1}{2}$ -inch square opening. The first gives fair appearance but practically no screening from view; the second gives good appearance with but little screening from view; and the third gives good appearance and good screening from view.

The panels for screening live parts, bus-bars, etc., are of No. 13 gauge expanded metal with 1 x 2-inch diamond mesh. See Figs. 5, 6 and 7.

**Frames** for grille panels are of 1 x 1 x  $\frac{1}{2}$ -inch angle iron with holes punched in the side constituting

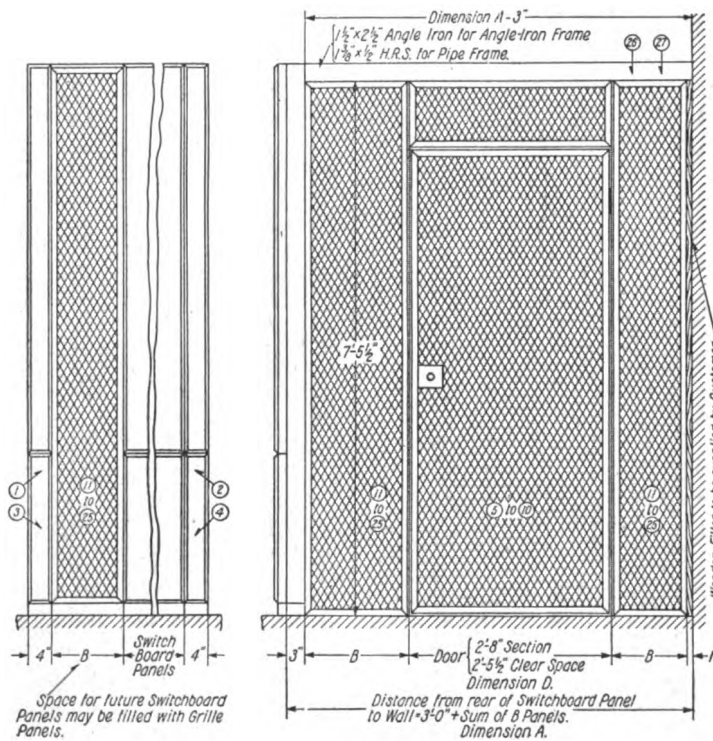


FIG. 1

FIG. 2

classes of screening are in line with the requirements of the National Electrical Safety Code and greatly enhance the value of the installation.

**Grille panels** of selected dimensions and weave have been standardized to promote delivery and are herein listed. The panels are easily removable and give access to switching equipment for cleaning, etc.

**The door section** is complete in itself, forming a panel 2 feet 8 inches wide. It is provided with lock and keys and may be inserted at any desired location in the grillework.

**Mesh of Panels**—Three different forms of mesh are provided for panels enclosing switchboards: first, panels of No. 13 gauge expanded metal with 1 x 2 inch diamond mesh; second, No. 17 gauge flat wire

the edge of the panel for bolting to adjacent panels or to supports.

**Finish**—The grillework is finished in dull black to match the standard finish of the board and other equipment.

**Description of Illustrations**—Fig. 1 shows the front of a switchboard for future equipment, the grille panel occupying the place of the future switchboard panel.

Fig. 2 shows grillework at the end of the switchboard, running from switchboard to wall. The door section may be placed next to the switchboard without any intervening grille panel, or next to the wall without any intervening grille panel.



GRILLEWORK PANELS FOR SWITCHBOARDS—Continued

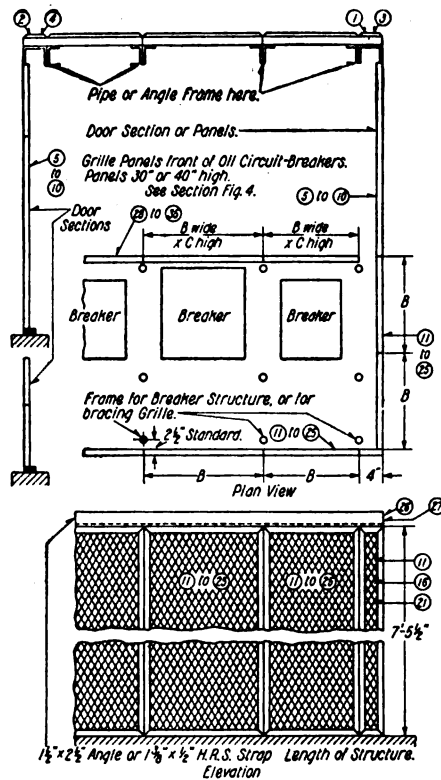


FIG. 3

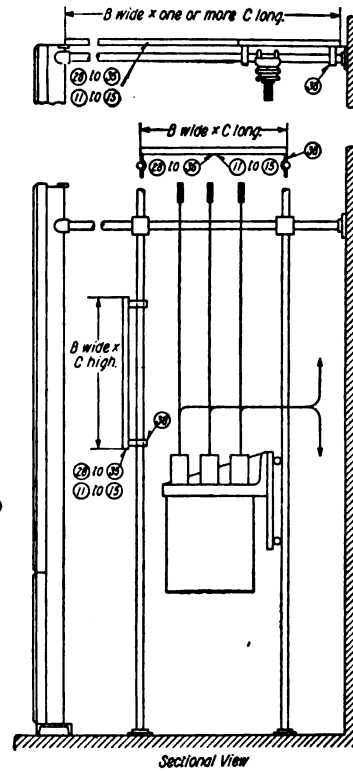


FIG. 4

Fig. 3 shows elevation of rear grillework enclosing a switchboard when the switchboard framework is self-supporting and independent of the wall support.

It also shows a plan view of a complete switchboard enclosure, and screens for oil circuit-breakers.

Fig. 4 shows screens for breakers and bus-bars.

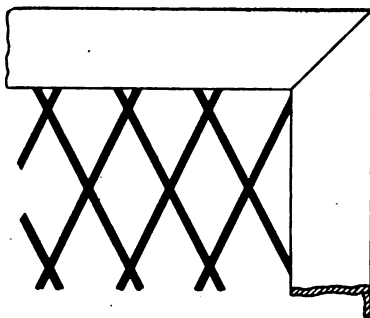


FIG. 5

Fig. 5 shows 1 x 2-inch diamond mesh of No. 13 gauge expanded metal.

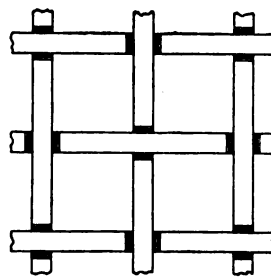


FIG. 6

Fig. 6 shows 1-inch square mesh of No. 17 gauge flat wire, 1/4-inch in width.

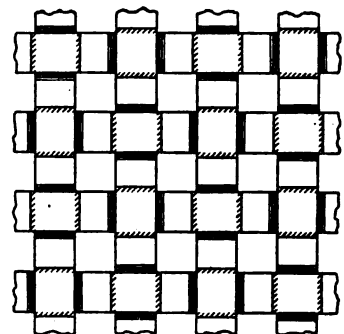


FIG. 7

Fig. 7 shows 1/2-inch square mesh of No. 16 gauge flat wire, 1/4-inch in width.

## GRILLEWORK PANELS FOR SWITCHBOARDS—Continued

## STANDARD GRILLEWORK PANELS AND ACCESSORIES

The various standard grille panels and accessories are listed in the following tables by style number, by which they should be ordered. Refer to Figures on preceding pages.

## Grille Panels

Description	Application	Item No.	Form of Mesh Fig.	REFERENCE DIMENSIONS, INCHES		Style No.
				B	C	
Door section complete.	Fig. 2 as shown.	5	5	..	..	266378
Door section complete.	Fig. 2 opposite hand.	6	5	..	..	266379
Door section complete.	Fig. 2 as shown.	7	6	..	..	266380
Door section complete.	Fig. 2 opposite hand.	8	6	..	..	266381
Door section complete.	Fig. 2 as shown.	9	7	..	..	266382
Door section complete.	Fig. 2 opposite hand.	10	7	..	..	266383
Grille panel 7' 5½" x 4".	General.	11	5	4	..	266384
Grille panel 7' 5½" x 16".	General.	12	5	16	..	266385
Grille panel 7' 5½" x 20".	General.	13	5	20	..	266386
Grille panel 7' 5½" x 24".	General.	14	5	24	..	266387
Grille panel 7' 5½" x 32".	General.	15	5	32	..	266388
Grille panel 7' 5½" x 4".	General.	16	6	4	..	266389
Grille panel 7' 5½" x 16".	General.	17	6	16	..	266390
Grille panel 7' 5½" x 20".	General.	18	6	20	..	266391
Grille panel 7' 5½" x 24".	General.	19	6	24	..	266392
Grille panel 7' 5½" x 32".	General.	20	6	32	..	266393
Grille panel 7' 5½" x 4".	General.	21	7	4	..	266394
Grille panel 7' 5½" x 16".	General.	22	7	16	..	266395
Grille panel 7' 5½" x 20".	General.	23	7	20	..	266396
Grille panel 7' 5½" x 24".	General.	24	7	24	..	266397
Grille panel 7' 5½" x 32".	General.	25	7	32	..	266398
Grille panel 30" x 16" wide.	Fig. 4.	28	5	16	30	266401
Grille panel 30" x 20" wide.	Fig. 4.	29	5	20	30	266402
Grille panel 30" x 24" wide.	Fig. 4.	30	5	24	30	266403
Grille panel 30" x 32" wide.	Fig. 4.	31	5	32	30	266404
Grille panel 40" x 16" wide.	Fig. 4.	32	5	16	40	266405
Grille panel 40" x 20" wide.	Fig. 4.	33	5	20	40	266406
Grille panel 40" x 24" wide.	Fig. 4.	34	5	24	40	266407
Grille panel 40" x 32" wide.	Fig. 4.	35	5	32	40	266408

## Accessories

Description	Application	Item No.	Style No.
*Left-hand slate end panel complete with frame.	Fig. 1, for slate switchboard.	1	266374
*Right-hand slate end panel complete with frame.	Fig. 1, for slate switchboard.	2	266375
*Left-hand marble end panel complete with frame.	Fig. 1, for marble switchboard.	3	266376
*Right-hand marble end panel complete with frame.	Fig. 1, for marble switchboard.	4	266377
Side brace 1" x 2½" x ¼" angle.	Angle-iron-frame, length per order.	26	266399
Side brace 1½" x ½" hot-rolled steel.	Pipe frame, length per order.	27	266400
Bracket, angle-iron to grille panel.	Fig. 1, angle-iron-frame.	36	266409
Bracket, 1¼" pipe to grille panel.	Fig. 1, pipe-frame.	37	266410
Bracket, 1¼" pipe to grille panel.	Fig. 4, structure.	38	266411

\*For angle-iron-frame switchboard.—For pipe-frame switchboard, order should read "Same as Style No. ...., except for pipe-frame switchboard."

Order by Style Number

## OUTDOOR BUS-BAR SUPPORTS, TYPE R

The type R bus-bar supports are designed for outdoor service for voltages of 4500; 7500; 15,000; 25,000; 37,000; 50,000; 73,000; 88,000; 110,000; 132,000; 154,000; 187,000 and 220,000 volts.

These supports up to 73,000 volts can also be used for indoor service at an increased voltage rating. The 88,000 to 220,000 volt supports can be used for indoor service at the same voltage rating.

Standard insulator units with cemented caps and pins are used for these supports and these insulator units are interchangeable with the insulator units which are used with standard line of outdoor mounting switching and protective apparatus. The use of standard insulator units has the advantage of interchangeability of all insulators on all apparatus used in outdoor switching stations. It also adds greatly to the appearance of the structure and reduces the number of spare insulators to be carried in stock by the customer.

The insulators used on the standard insulator units are the faradoid pin-type line insulators with a heavy brown glaze. The pins used with the lower voltage insulator units are cast iron; those used with the intermediate voltages are malleable iron and those used with the higher voltages are cast steel. All pins are hot galvanized.

The base of the pins of all insulator units have four holes located 90 degrees apart, permitting the support to be turned on its vertical axis, depending on the direction of the bus or conductor supported.

The caps used with all insulator units are pressed steel, hot-galvanized and drilled and tapped for 2 tap bolts for attaching fittings.

A complete line of fittings for bolting both to the pins and caps of the insulator units permits these bus-bar supports to be mounted on a flat surface or on a pipe, either in the upright or inverted position, and to be used for supporting either flat strap or round conductor.

These combinations of mounting and supporting fittings are available for all voltages up to and including 37,000 volts. For the 50,000; 73,000; 88,000; 110,000; 132,000; 154,000; 187,000 and 220,000-volt bus supports, these fittings are available for mounting the bus-bar supports either upright or inverted on a flat surface and for supporting tubing or round conductor. However, the higher voltage supports are recommended for upright mounting only.

This line of fittings is complete and very flexible and should meet all requirements of supporting bus and connections in outdoor switching stations for all capacities, voltages and classes of service.

The fittings are made of malleable iron or steel, hot-galvanized and the bolts, nuts and washers used for holding the fittings to the pins and caps of the insulators are sherardized.

The bolts used for holding the clamping plates for the flat bars are brass with iron nuts and washers. The U-bolts used for fastening tubing to round

conductor are brass with iron nuts and washers.

**Type R outdoor bus-support for upright mounting on flat surface and for supporting flat strap.** The bus-clamp is of the three-bolt clamp type and will accommodate bus-straps up to 3 inches wide.

**Style number** includes bus clamping bolts for 1¼-inch bus space.

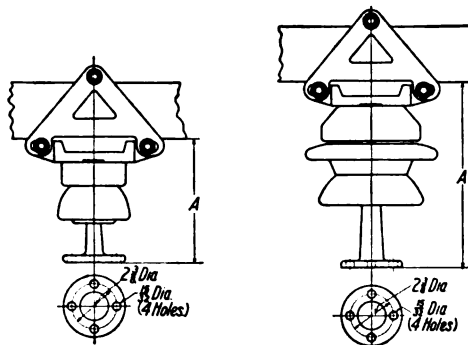


FIG. 1

FIG. 2

Complete Support Style No.	Service Voltage	Height of Bus Inches	Fig. No.	Approx. Dim. Inches A	Approx. Shipping Wt. Lbs.
378844	4500	3	1	6%	9
378845	7500	3	1	8%	10
378848	15000	3	2	9%	13
378849	25000	3	2	11%	20
378850	37000	3	2	13½%	39

**Type R outdoor bus-support for inverted mounting on flat surface and for supporting flat strap.** The bus-clamp is of the three-bolt clamp type and will accommodate bus-straps up to 3 inches wide.

**Style number** includes bus clamping bolts for 1¼-inch bus space.

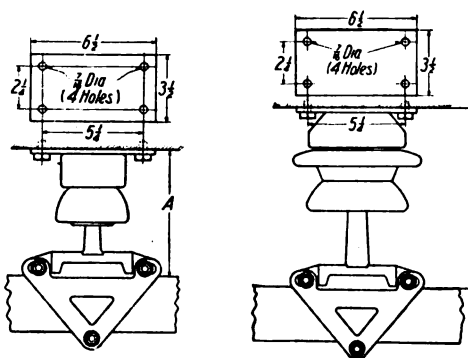


FIG. 3

FIG. 4

Complete Support Style No.	Service Voltage	Height of Bus Inches	Fig. No.	Approx. Dim. Inches A	Approx. Shipping Wt. Lbs.
378846	4500	3	3	6%	10
378847	7500	3	3	8%	11
378851	15000	3	4	9%	14
378852	25000	3	4	11%	21
378853	37000	3	4	13½%	40

Order by Style Number

OUTDOOR BUS-BAR SUPPORTS, TYPE R—Continued

Type R outdoor bus-support for upright mounting on pipe and for supporting flat strap. The bus-clamp is of the three-bolt type and will accommodate bus-straps up to 3 inches wide.

Style number includes bus clamping bolts for 1¼-inch bus space and bases for 1¼ or 2-inch pipe.

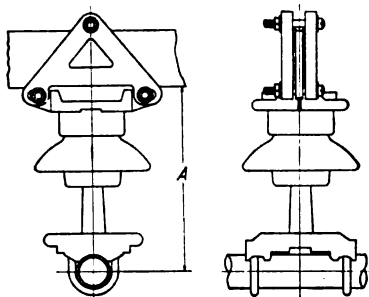


FIG. 5

Complete Support Style No.	Service Voltage	Height of Bus Inches	Diam. of Pipe Support Inches	Fig. No.	Approx. Dim. Inches A	Approx. Shipping Wt. Lbs.
378854	4500	3	1¼	5	8¼	11
378855	4500	3	2	5	8⅝	11
378856	7500	3	1¼	5	10	12
378857	7500	3	2	5	10⅜	12
378922	15000	3	1¼	6	11¼	15
378923	15000	3	2	6	11⅝	15
378924	25000	3	1¼	6	13¼	21
378925	25000	3	2	6	13⅝	21
378926	37000	3	1¼	6	14¼	28
378927	37000	3	2	6	15⅝	28

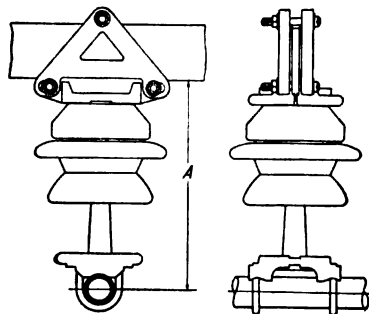


FIG. 6

Type R outdoor bus-support for inverted mounting on pipe and for supporting flat strap. The bus clamp is of three-bolt type and will accommodate bus straps up to 3 inches wide.

Style number includes bus clamping bolts for 1¼-inch bus space, and bases for 1¼ or 2-inch pipe.

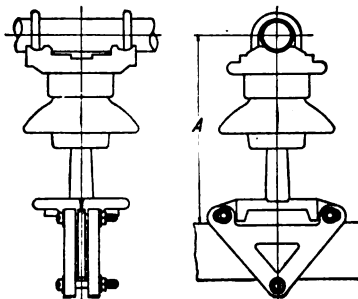


FIG. 7

Complete Support Style No.	Service Voltage	Height of Bus Inches	Diam. of Pipe Support Inches	Fig. No.	Approx. Dim. Inches A	Approx. Shipping Wt. Lbs.
378858	4500	3	1¼	7	8¼	10
378859	4500	3	2	7	8⅝	11
378860	7500	3	1¼	7	10	12
378861	7500	3	2	7	10⅜	13
378928	15000	3	1¼	8	11¼	15
378929	15000	3	2	8	11⅝	15
378930	25000	3	1¼	8	13¼	21
378931	25000	3	2	8	13⅝	21
378932	37000	3	1¼	8	14¼	28
378933	37000	3	2	8	15⅝	28

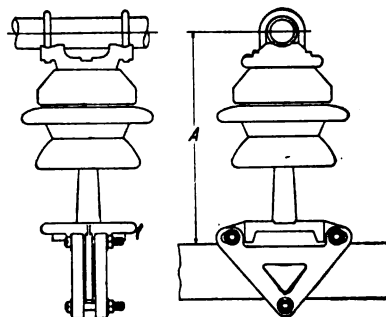


FIG. 8

Type R outdoor bus-support for upright mounting on flat surface and for supporting round conductor.

Style number includes U-bolts for clamping round conductor having an outside diameter up to 2½ inches.

Order by Style Number

OUTDOOR BUS-BAR SUPPORTS, TYPE R—Continued

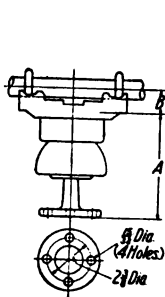


FIG. 9

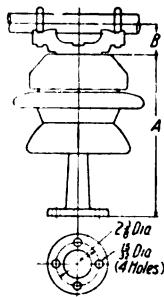


FIG. 10

Complete Support Style No.	Service Voltage	Outside Dia. of Bus Inches	Fig. No.	Approx. Dim., Inches A	Approx. Dim., Inches B	Approx. Shipping Wt. Lbs.
378862	4500	Max. 3/4	9	5 3/4	1 1/2	5
378863	4500	3/4 to 1 1/8	9	5 3/4	1 3/8	5
378864	4500	1 1/8 to 1 3/8	9	5 3/4	1 5/8	5
378865	4500	1 3/8 to 1 7/8	9	5 3/4	1 3/4	5
378866	4500	1 7/8 to 2 1/8	9	5 3/4	2	5
378867	4500	2 1/8 to 2 3/4	9	5 3/4	2 1/4	5
378868	7500	Max. 3/4	9	7 1/2	1 1/2	6
378869	7500	3/4 to 1 1/8	9	7 1/2	1 3/8	6
378870	7500	1 1/8 to 1 3/8	9	7 1/2	1 5/8	6
378871	7500	1 3/8 to 1 7/8	9	7 1/2	1 3/4	6
378872	7500	1 7/8 to 2 1/8	9	7 1/2	2	6
378873	7500	2 1/8 to 2 3/4	9	7 1/2	2 1/4	6
378904	15000	Max. 3/4	10	8 3/4	1 1/2	9
378905	15000	3/4 to 1 1/8	10	8 3/4	1 3/8	9
378906	15000	1 1/8 to 1 3/8	10	8 3/4	1 5/8	9
378907	15000	1 3/8 to 1 7/8	10	8 3/4	1 3/4	9
378908	15000	1 7/8 to 2 1/8	10	8 3/4	2	9
378909	15000	2 1/8 to 2 3/4	10	8 3/4	2 1/4	9
378910	25000	Max. 3/4	10	10 3/4	1 1/2	15
378911	25000	3/4 to 1 1/8	10	10 3/4	1 3/8	15
378912	25000	1 1/8 to 1 3/8	10	10 3/4	1 5/8	15
378913	25000	1 3/8 to 1 7/8	10	10 3/4	1 3/4	15
378914	25000	1 7/8 to 2 1/8	10	10 3/4	2	15
378915	25000	2 1/8 to 2 3/4	10	10 3/4	2 1/4	15
378916	37000	Max. 3/4	10	12 1/4	1 1/2	21
378917	37000	3/4 to 1 1/8	10	12 1/4	1 3/8	21
378918	37000	1 1/8 to 1 3/8	10	12 1/4	1 5/8	21
378919	37000	1 3/8 to 1 7/8	10	12 1/4	1 3/4	21
378920	37000	1 7/8 to 2 1/8	10	12 1/4	2	21
378921	37000	2 1/8 to 2 3/4	10	12 1/4	2 1/4	21

Complete Support Style No.	Service Voltage	Outside Dia. of Bus Inches	Fig. No.	Approx. Dim., Inches A	Approx. Dim., Inches B	Approx. Shipping Wt. Lbs.
378874	4500	Max. 3/4	11	6	1 1/2	6
378875	4500	3/4 to 1 1/8	11	6	1 3/8	6
378876	4500	1 1/8 to 1 3/8	11	6	1 5/8	6
378877	4500	1 3/8 to 1 7/8	11	6	1 3/4	6
378878	4500	1 7/8 to 2 1/8	11	6	2	6
378879	4500	2 1/8 to 2 3/4	11	6	2 1/4	6
378880	7500	Max. 3/4	11	7 3/4	1 1/2	7
378881	7500	3/4 to 1 1/8	11	7 3/4	1 3/8	7
378882	7500	1 1/8 to 1 3/8	11	7 3/4	1 5/8	7
378883	7500	1 3/8 to 1 7/8	11	7 3/4	1 3/4	7
378884	7500	1 7/8 to 2 1/8	11	7 3/4	2	7
378885	7500	2 1/8 to 2 3/4	11	7 3/4	2 1/4	7
378886	15000	Max. 3/4	12	9	1 1/2	10
378887	15000	3/4 to 1 1/8	12	9	1 3/8	10
378888	15000	1 1/8 to 1 3/8	12	9	1 5/8	10
378889	15000	1 3/8 to 1 7/8	12	9	1 3/4	10
378890	15000	1 7/8 to 2 1/8	12	9	2	10
378891	15000	2 1/8 to 2 3/4	12	9	2 1/4	10
378892	25000	Max. 3/4	12	11	1 1/2	16
378893	25000	3/4 to 1 1/8	12	11	1 3/8	16
378894	25000	1 1/8 to 1 3/8	12	11	1 5/8	16
378895	25000	1 3/8 to 1 7/8	12	11	1 3/4	16
378896	25000	1 7/8 to 2 1/8	12	11	2	16
378897	25000	2 1/8 to 2 3/4	12	11	2 1/4	16
378898	37000	Max. 3/4	12	12 1/2	1 1/2	22
378899	37000	3/4 to 1 1/8	12	12 1/2	1 3/8	22
378900	37000	1 1/8 to 1 3/8	12	12 1/2	1 5/8	22
378901	37000	1 3/8 to 1 7/8	12	12 1/2	1 3/4	22
378902	37000	1 7/8 to 2 1/8	12	12 1/2	2	22
378903	37000	2 1/8 to 2 3/4	12	12 1/2	2 1/4	22

Type R outdoor bus-support for both upright and inverted mounting on pipe and for supporting round conductor.

Style number includes mounting for 1 1/4 and 2-inch pipe and U-bolts for clamping round conductor having an outside diameter up to 2 1/2 inches. The top and bottom fittings are interchangeable for the two types of mounting.

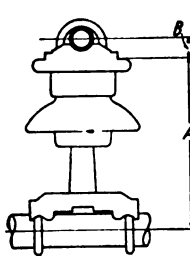


FIG. 13

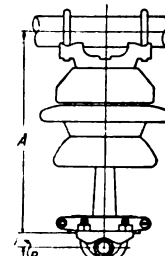


FIG. 14

Type R outdoor bus-support for inverted mounting on flat surface and for supporting round conductor.

Style number includes U-bolts for clamping round conductor having an outside diameter up to 2 1/2 inches.

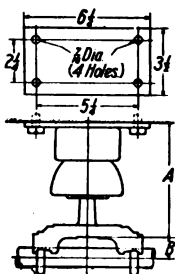


FIG. 11

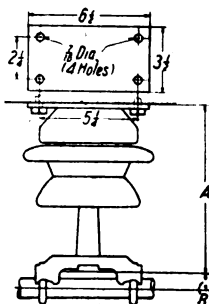


FIG. 12

Table for Fig. 13

Complete Support Style No.	Service Voltage	Outside Dia. of Bus Inches	Dia. of Support Pipe Inches	Fig. No.	Approx. Dim., Inches A	Approx. Dim., Inches B	Approx. Shipping Wt. Lbs.
379030	4500	Max. 3/4	1 1/4	13	7 3/4	1 1/2	4 1/2
379031	4500	3/4 to 1 1/8	1 1/4	13	7 3/4	1 3/8	4 1/2
379032	4500	1 1/8 to 1 3/8	1 1/4	13	7 3/4	1 5/8	4 1/2
379033	4500	1 3/8 to 1 7/8	1 1/4	13	7 3/4	1 3/4	4 1/2
379034	4500	1 7/8 to 2 1/8	1 1/4	13	7 3/4	2	4 1/2
379035	4500	2 1/8 to 2 3/4	1 1/4	13	7 3/4	2 1/4	4 1/2
379036	4500	Max. 3/4	2	13	7 5/8	1 1/2	4 1/2
379037	4500	3/4 to 1 1/8	2	13	7 5/8	1 3/8	4 1/2
379038	4500	1 1/8 to 1 3/8	2	13	7 5/8	1 5/8	4 1/2
379039	4500	1 3/8 to 1 7/8	2	13	7 5/8	1 3/4	4 1/2
379040	4500	1 7/8 to 2 1/8	2	13	7 5/8	2	4 1/2
379041	4500	2 1/8 to 2 3/4	2	13	7 5/8	2 1/4	4 1/2
379042	7500	Max. 3/4	1 1/4	13	9 3/8	1 1/2	5
379043	7500	3/4 to 1 1/8	1 1/4	13	9 3/8	1 3/8	5
379044	7500	1 1/8 to 1 3/8	1 1/4	13	9 3/8	1 5/8	5
379045	7500	1 3/8 to 1 7/8	1 1/4	13	9 3/8	1 3/4	5
379046	7500	1 7/8 to 2 1/8	1 1/4	13	9 3/8	2	5
379047	7500	2 1/8 to 2 3/4	1 1/4	13	9 3/8	2 1/4	5
379048	7500	Max. 3/4	2	13	9 3/8	1 1/2	5
379049	7500	3/4 to 1 1/8	2	13	9 3/8	1 3/8	5
379050	7500	1 1/8 to 1 3/8	2	13	9 3/8	1 5/8	5
379051	7500	1 3/8 to 1 7/8	2	13	9 3/8	1 3/4	5
379052	7500	1 7/8 to 2 1/8	2	13	9 3/8	2	5
379053	7500	2 1/8 to 2 3/4	2	13	9 3/8	2 1/4	5

Order by Style Number



## PILLAR INSULATORS

### SECTIONAL TYPE



SINGLE UNIT, STYLE NUMBER 329628

These insulators are designed to be bolted together into columns containing as many units as are required to meet the conditions of service. The units are interchangeable, being equipped with top and bottom fittings tapped and drilled for tap bolts. Suitable for both indoor and outdoor service, these insulators are used for mounting bus bars and conductors, also for mounting switching and protective apparatus.

The unit complete with cap and pin is 15 inches high.

Each unit is built up of 3 porcelain sections cemented together. The porcelains have a uniform chocolate brown glaze. To prevent cracking, the top of each is covered with an elastic compound. To withstand mechanical injury during handling, the porcelains have a thick rim. For gripping the cement, the contact surfaces of the porcelains are sanded. Hot galvanized caps and pins of malleable iron are cemented to the porcelains with portland cement by the steam curing process which eliminates strains in the porcelain. This cementing is done in jigs to insure uniformity in height and also to line up the bolt holes in the caps and pins.

The units are fastened together by four  $\frac{3}{8}$ -inch diameter tap bolts. The use of these units is recommended for insulator columns up to six units.

The average ultimate mechanical strength of a single insulator is as follows:

Cantilever, 75,000 - inch pounds.

Torsion, 56,000-inch pounds

Tension, 17,500 pounds.

For outdoor service, 3 units are recommended for 132,000-volt service; 4 units for 154,000; 5 units for 187,000 and 6 units for 220,000.

Style number includes single unit only.



A FOUR-UNIT COLUMN FOR 154,000-VOLT OUTDOOR SERVICE

No. of Units in Column	Dry Arc-Over Volts	Wet Arc-Over with 10 Inches
		Precipitation per Minute Volts
1	150,000	110,000
2	300,000	250,000
3	430,000	390,000
4	540,000	510,000
5	630,000	590,000
6	710,000	670,000

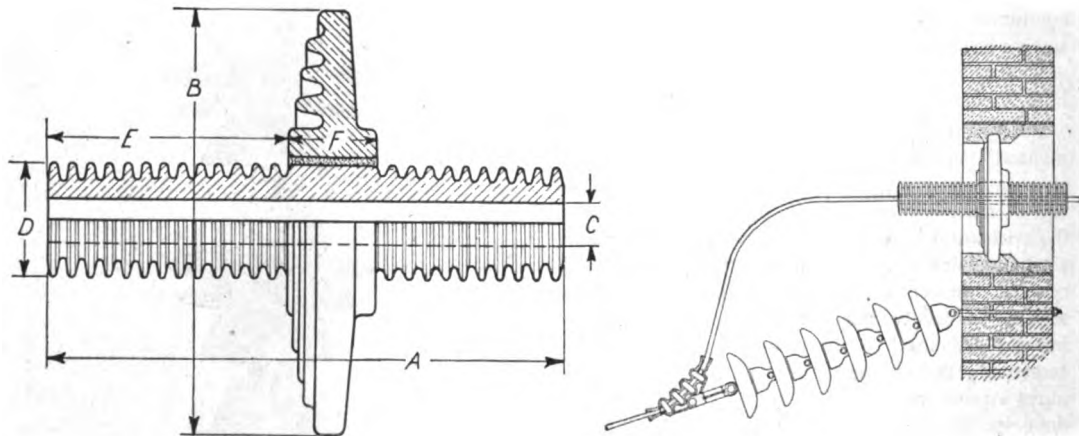
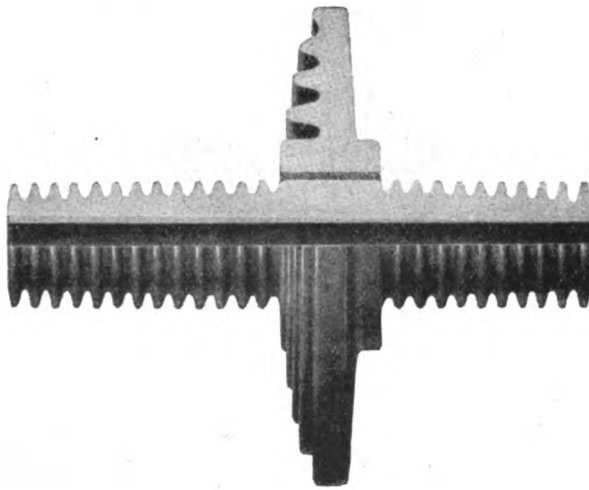
Style No.  
329628

Description  
Single unit only

Net Weight Lbs.  
90

Order by Style Number

PORCELAIN WALL BUSHINGS

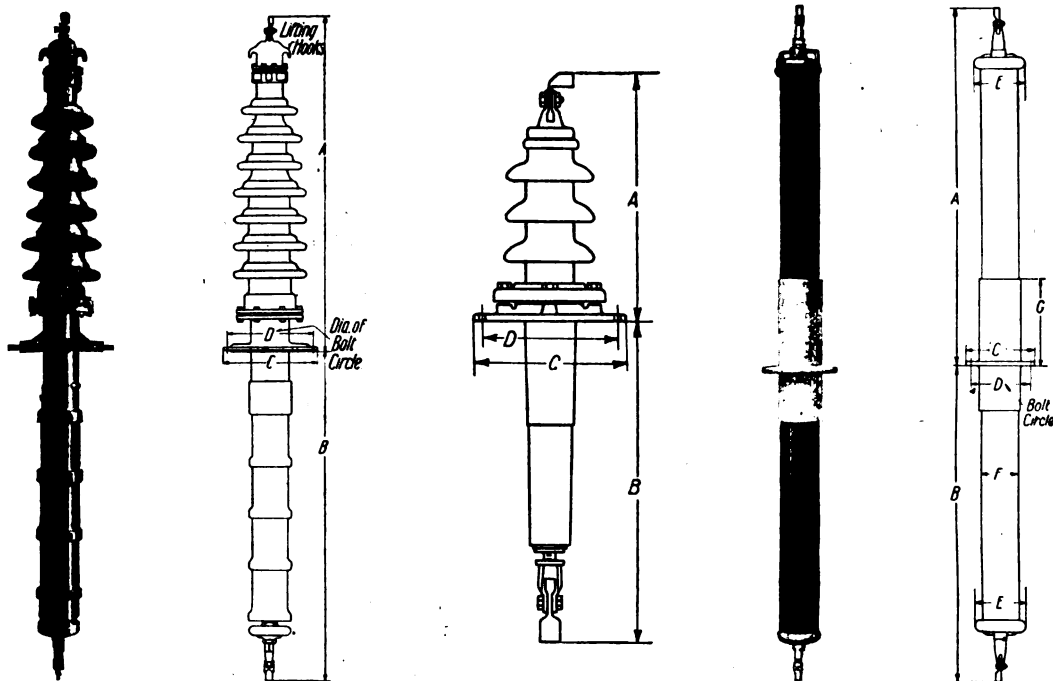


Style No. ....	195205	195206	195207	312996	312997	383595
Service Voltage. ....	11000	13000	22000	33000	44000	66000
Dry arc-over voltage. ....	65000	70000	85000	100000	120000	170000
Leakage distance, inches. ....	19	21	26½	33½	43	48
Diameter in inches (B) . . . . .	12	14	14	16	18	22¾
Length in inches (A) . . . . .	14	14	20	22	24	36
Diameter hole, inches (C) . . . . .	1¼	1¼	1¼	1½	1½	2¼
Diameter tube, inches (D) . . . . .	3¾	3¾	3¾	4	4¾	6
Dimension E in inches . . . . .	6½	6½	9½	10¾	11¼	18
Dimension F in inches. . . . .	2¾	2¾	2¾	3½	4¼	6
Approximate net weight each in pounds. ....	23	27	34	50	65	115
Approximate weight packed each in pounds. ....	47	52	97	110	130	160
Number per barrel or crate.	2	2	1	1	1	1
List price each. ....	\$17 20	20 41	21 90	42 00	46 50	108 00

Order by Style Number



## ROOF AND WALL BUSHINGS CONDENSER TYPE



ROOF BUSHING

ROOF BUSHINGS STYLE NOS.  
383593 AND  
383594

WALL OR FLOOR BUSHING

The roof bushings listed in the following table cover a range of service voltages from 15,000 to 187,000. The 15,000 and 25,000-volt bushings are constructed of micarta tubes within a porcelain housing. The 33,000 to 187,000-volt bushings are of the condenser type. They should not be installed at an angle to the vertical exceeding 10 degrees and cannot be used in a horizontal position. Mechanical stress due to the line must be taken up by the use of strain insulators as the bushings are not designed to withstand such mechanical stresses.

The condenser type wall or floor bushings can be used at any angle. They cannot be used outdoors or where water will condense on the bushing, but are for indoor service only.

These bushings are regularly made for a maximum current of 200 amperes, but the current capacity can be increased at slight cost. A pressed tube copper terminal is regularly furnished at both ends and can be set at any angle or direction.

Prices and detailed dimensions will be quoted on application.

### ROOF BUSHINGS

Style No.	Voltage Class*	Leakage Dist. Outdoor End	APPROXIMATE DIMENSIONS IN INCHES					BOLTS No. and Size	APPROX. WT. LBS., EACH	
			A	B	C	D	Net		Crated	
383594	15000	15	17 3/4	22 1/4	12	11	4 of 5/8	45	90	
383593	25000	22	21 3/8	23 3/8	12	11	4 of 5/8	55	110	
383592	33000	28	28 1/2	32 1/2	12	11	4 of 5/8	120	240	
268250	44000	35	42	45	16 1/4	15	4 of 5/8	275	550	
268251	66000	52 1/2	54	55	21	19 1/4	6 of 5/8	425	700	
268252	88000	80	65	65	21	19 1/4	6 of 5/8	575	1100	
268253	110000	95	73	73	21	19 1/4	6 of 5/8	725	1425	
268254	132000	105	82	82	21	19 1/4	6 of 3/4	1100	2200	
268255	154000	130	90	90	21	19 1/4	6 of 3/4	1500	2500	
381363	187000	155	103	105	35 3/4	33 3/4	12 of 1	2500	4000	

Current transformers may be mounted below the flange on voltages up to 115,000. Higher voltages will require a suspension from the underside of the roof to carry the current transformer. The minimum satisfactory primary current for operating relays or indicating instruments is approximately 75 amperes. Dimension E in the above table will be increased if a current transformer is mounted on the bushing.

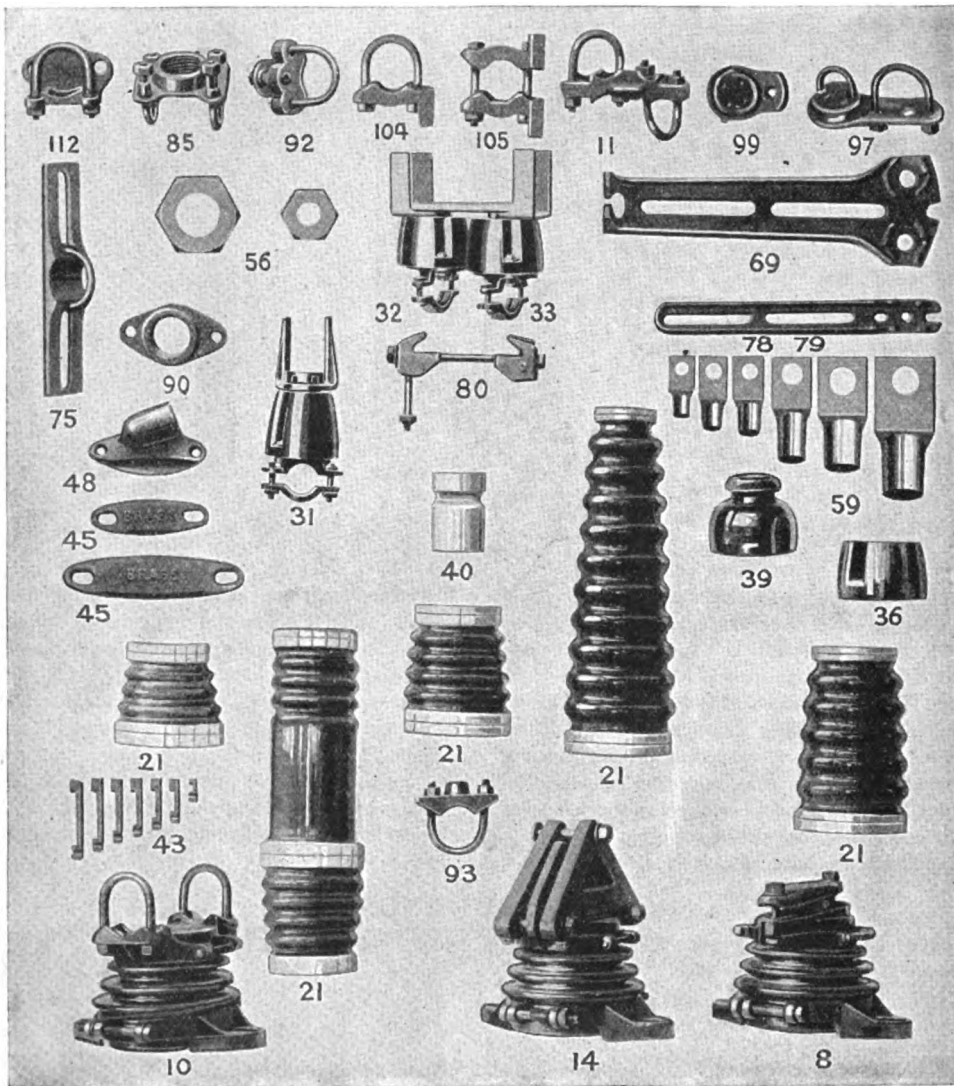
### WALL OR FLOOR BUSHINGS

Style No.	Voltage Class*	APPROXIMATE DIMENSIONS IN INCHES						BOLTS No. and Size	APPROX. WT. LBS., EACH		
		A	B	C	D	E	F		G	Net	Crated
268346	66000	52	47	13	11	9 1/4	5 1/4	15	4 of 5/8	225	400
268347	88000	64	59	13	11	9 1/4	7 1/4	15	4 of 5/8	350	660
268348	110000	72	65	13	11	9 1/4	8 1/4	15	4 of 5/8	450	800
268349	132000	80	73	20	17 1/2	15 1/4	9 1/4	15	6 of 5/8	700	1200
268350	154000	88	81	20	17 1/2	15 1/4	10 1/4	15	6 of 3/4	1075	1600
381362	187000	100	96	23	20	18	12 1/4	15	12 of 1	1800	2800

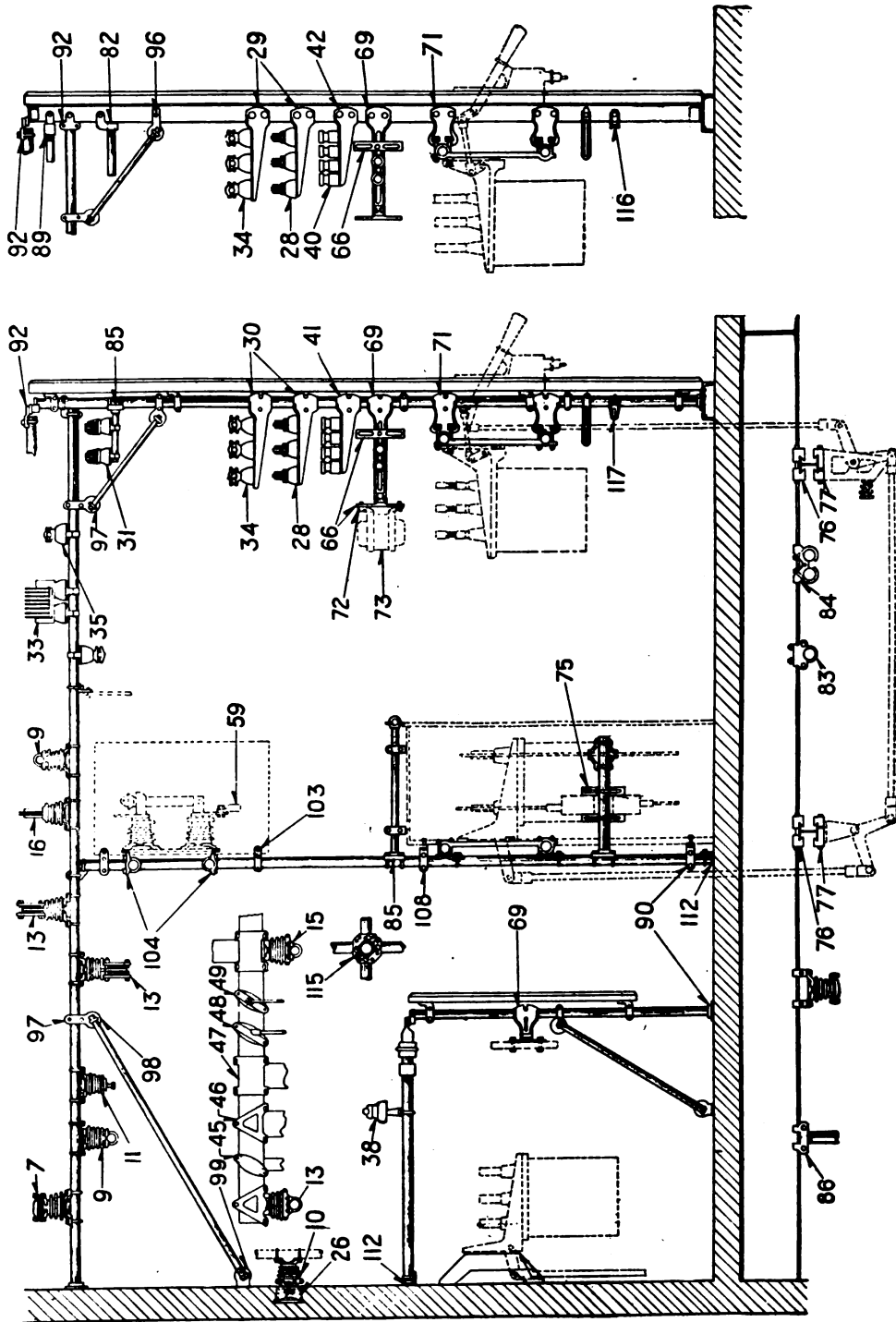
\*Bushings may be operated continuously at 5 per cent above the class voltage.

### SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS

In the following pages there are listed various details developed and used by the Westinghouse Electric & Manufacturing Company in the design and building of switchboards for all classes of service. This detail apparatus meets every requirement of the National Board of Fire Underwriters.



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued



APPLICATION OF THE VARIOUS DETAIL PARTS LISTED  
The numbers shown above refer to the "Index to Details"  
and also to the detail views on the following pages.

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

INDEX TO DETAILS

(Refer to numbers on Fig. on preceding page and to detail views on following pages.)

DESCRIPTION	FIGURE	DESCRIPTION	FIGURE
Barrier brackets for pipe mounting . . .	102, 103	Mounting brackets for meters . . . . .	127 to 130, 132, 133
Beveled washers for front of panel . . . . .		Mounting clamp brackets . . . . .	104 to 109, 116, 117
Bolts, insulated and uninsulated . . . . .	135, 137	Nameplates . . . . .	
Bus supports with corrugated insulators	3 to 20	Nuts, fancy hexagon, special finish . . . . .	136
Bus-bar brackets . . . . .	25, 29, 30	Nuts for contact studs . . . . .	65
Bus-bar clamps . . . . .	45, 46, 47	Pipe braces and clamps . . . . .	92, 95
Bus-bar copper . . . . .		Pipe end caps . . . . .	110
Bus-bar supports rear connected, type P	22	Pipe brackets . . . . .	82
Bus-bar terminals . . . . .	48, 49	Pipe cross clamps . . . . .	114, 115
Bus-rod brackets and supports . . . . .	34, 35, 37, 38, 41, 42	Pipe ends . . . . .	89, 90
Bus-strap brackets . . . . .	25	Pipe end clamps . . . . .	86
Bus-strap supports . . . . .	28, 31, 32, 33	Pipe flanges . . . . .	
Bus wire and insulated turnbuckles . . . . .	44	Pipe flange clamps . . . . .	112
Card holders . . . . .	138	Pipe mounting brackets . . . . .	74, 75, 81, 93, 94
Clamps . . . . .	83, 84	Pipe saddle clamps . . . . .	85
Connectors, Tee . . . . .	50, 51	Shunt lead holder . . . . .	121
Connectors, of copper tubing . . . . .	52, 55	Shunt supporting brackets . . . . .	125
I-Beam clamps . . . . .	76, 77, 80	Switchboard mountings for rheostats . . . . .	124
Idler brackets with idlers . . . . .	118, 119	Terminals . . . . .	56, 65
Insulators, corrugated porcelain . . . . .	21, 24	Universal auxiliary brackets . . . . .	66
Insulators, plain porcelain . . . . .	36, 39, 40	Universal mounting brackets . . . . .	67, 69, 70, 71
Metal caps for switchboards . . . . .	134	Universal mounting blocks . . . . .	26
Micarta cleats . . . . .	43	Universal mounting straps . . . . .	68
Mounting brackets for condenser sections	78, 79	Wall braces with angular adjustment . . . . .	87, 96, 97, 98, 99, 100
Mounting brackets for current transformers . . . . .	72, 73		

MECHANICAL STRESSES ON BUS-BARS

Mechanical stresses due to short circuits on the bus-bars must be considered in selecting the type and size of support. These short-circuit stresses may depend on the maximum ampere load, under short-circuit conditions, the distance between center lines of bus-bars, and the relative location of the bus-bars

The magnitude of these stresses with varying kv-a. capacities, impedances, bus spacings, etc., is graphically shown in the charts, Figs. 1 and 2.

These are self-explanatory and with the examples worked out on each chart, should offer a ready means for taking care of problems of this nature.

\*Formulae for calculating the stresses are given below.

To find the maximum force exerted between bus-bars caused by a single-phase or three-phase short-circuit current on a three-phase system, the busses arranged in a plane:

\*Results obtained from the formulae are theoretical. In practice allowances can sometimes be made for the inertia of the bus structure, the flexibility of the bus supports and the decrement of the generating equipment. The company will furnish recommendations on request.

Let F = maximum force exerted in lbs. per ft. of bus.

kv-a. = normal rating of station, including all synchronous apparatus.

A = distance between busses in inches.

Z = impedance in per cent, expressed in decimals, to point of short-circuit.

V = line voltage.  
 $.27 \times (kv-a.)^2$

$$\text{Then } F = \frac{.27 \times (kv-a.)^2}{A \times V^2 \times Z^2}$$

To find the kv-a. rating of a support for use on a system with an impedance different from that given in the table,

Let kv-a. = rating given in table.

Z = per cent impedance used in table, expressed in decimals.

kv-a.<sup>-1</sup> = new kv-a. rating.

Z<sup>-1</sup> = new per cent impedance expressed in decimals.

$$\text{Then } kv-a.^{-1} = kv-a. \times \frac{Z^{-1}}{Z}$$

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

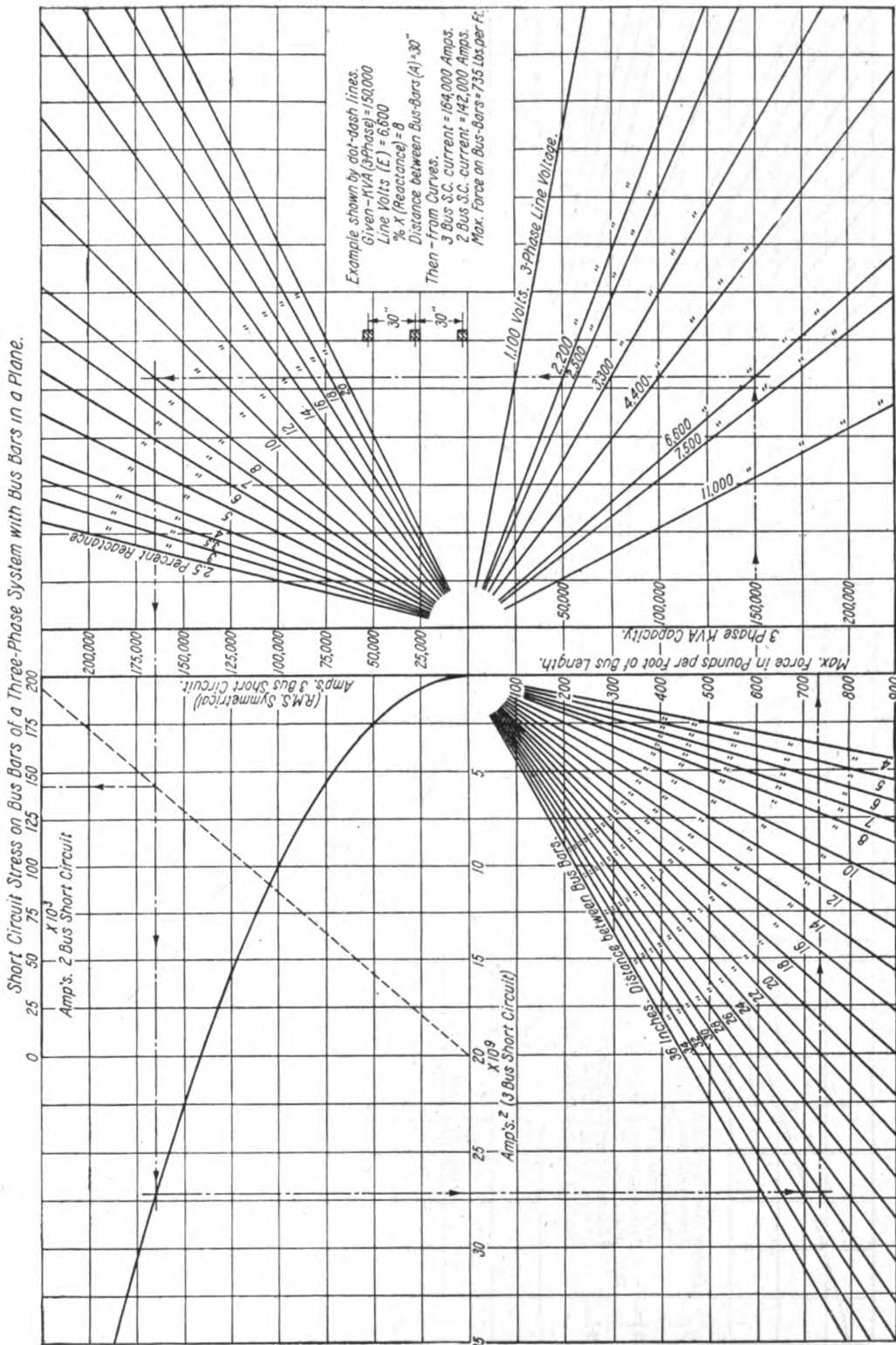


FIG. 1

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

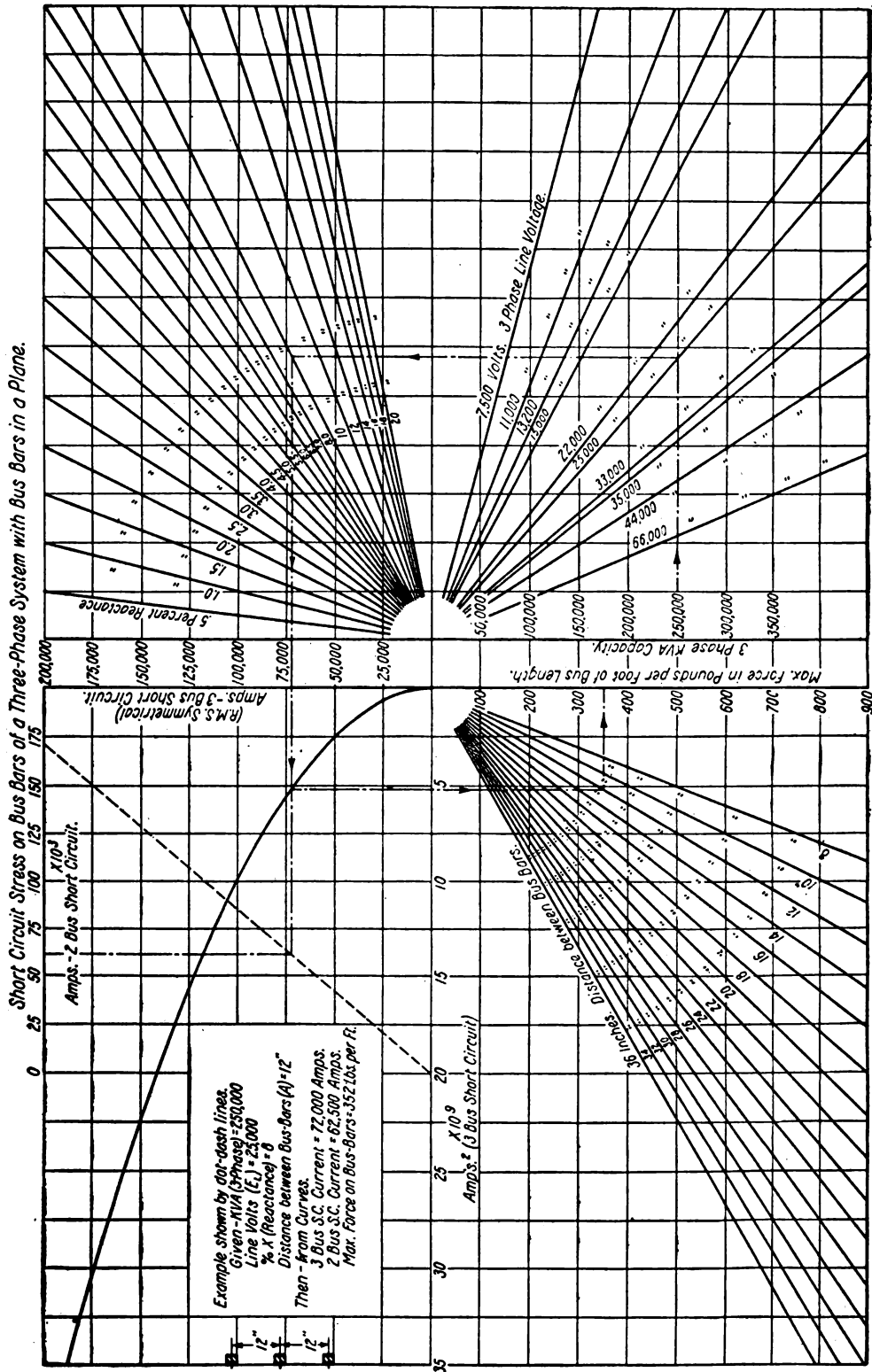


FIG. 2

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

TYPE P BUS-BAR SUPPORTS

Standard Applications and Ratings

These supports consist essentially of an insulator with suitable bus and mounting fixtures clamped on.

The insulators are made of porcelain by wet process and have a brown mahogany glaze. The insulators are corrugated to insure ample creepage surface under service conditions.

The fittings are made of malleable iron or cast brass and have a high grade, dull black, baked finish.

Interchangeability of fittings on porcelains of different voltage but of same diameter of head or base is provided for.

Voltage tests with all fittings on are given in table below. These tests are ample for ordinary applications and are well within the requirements of the recommendations of the American Institute of Electrical Engineers. The large creepage surface provided by the corrugations insures the ability of the insulator to stand the same test under service conditions.

For exceptional installations where an insulator of a higher voltage test may be desired, select from the next higher maximum service class.

Maximum Service Voltage	One Minute Dry Test Volts
7500	20000
15000	40000
25000	65000
35000	90000
44000	115000

Applications—Standard supports are listed for mounting from a flat surface or from a pipe. Bus fittings are available for round busses and for rectangular straps, supported on flat surfaces or edges.

Fig. 3 shows some of the more common arrangements when mounted in cell structures.

Ratings—Standard ratings are given in the table below. When ratings required are in excess of those given, reference should be made to tables on succeeding pages, or to the nearest district office.

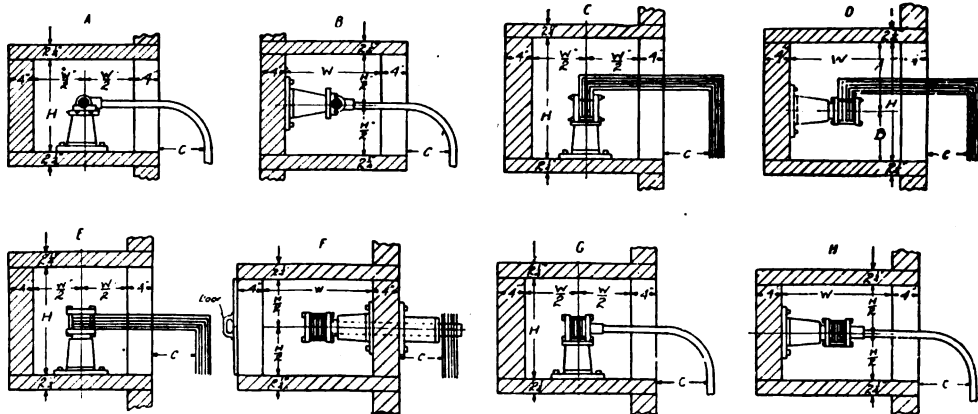


FIG. 3

Voltage	DIMENSIONS IN INCHES OF STANDARD ARRANGEMENTS OF BUS-BAR SUPPORTS																
	All	A		B		C		D*		E		F		G		H	
	C-Min	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W
2500	2	12	9	12	10 3/4	15 1/2	10	12	13 3/4	13 3/4	9	12	13 3/4	12	9 3/4	12	13 3/4
7500	3 1/4	12 1/4	11 1/2	12	12 3/4	17	13	14 3/4	14 3/4	14 3/4	11	12	14 3/4	13 3/4	12 3/4	12	14 3/4
15000	5 1/2	15 1/2	16 3/4	16 3/4	15 1/2	20 1/2	17 1/2	18 3/4	18 3/4	18 3/4	15 1/2	15 1/2	18 3/4	16 3/4	17 1/4	15 1/2	18 3/4

\*Dimension A for 2500 volts = 7 3/4 inches and B = 4 1/4 inches; for 7500 volts A = 8 3/4 inches and B = 5 1/2 inches.

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

TYPE P BUS-BAR SUPPORTS

Post-Type—Kv-a. Rating

Line Service Voltage	Insulator Base, Inches Diameter	Minimum Spacing Between Busses, Inches	Maximum Spacing Between Supports, Feet	KV-A. RATING OF SUPPORT, CORRESPONDING TO KV-A. RATING OF STATION, ASSUMING 10 PER CENT IMPEDANCE TO POINT OF SHORT CIRCUIT BUS MOUNTED ON EDGE		
				Round or Flat Bus	3 to 4-inch Bus	5 to 6-inch Bus
<b>For Light Duty</b>						
2500	2 7/8	6	3	10000	8000	.....
7500	2 7/8	8	3	35000	30000	.....
15000	2 7/8	10	3	60000	56000	.....
<b>For Medium Duty</b>						
2500	3 7/8	8	4	15000	13000	11000
7500	3 7/8	8	4	47000	41000	34500
15000	3 7/8	10	4	90000	81000	.....
25000	3 7/8	16	4	172000	160000	155000
<b>For Heavy Duty</b>						
2500	4 7/8	10	4	23000	21000	17000
2500	4 7/8	16	4	30000	26000	24500
2500	4 7/8	20	4	33000	29000	27500
2500	4 7/8	24	4	36000	32000	30000
7500	4 7/8	10	4	72000	64000	60000
7500	4 7/8	12	4	79000	70000	65000
7500	4 7/8	16	4	91500	81000	75000
7500	4 7/8	20	4	100000	91000	85000
7500	4 7/8	24	4	120000	100000	92000
15000	4 7/8	12	4	135000	125000	120000
15000	4 7/8	16	4	160000	145000	138000
15000	4 7/8	20	4	175000	160000	150000
15000	4 7/8	24	4	190000	175000	170000
25000	4 7/8	16	4	230000	220000	210000
25000	4 7/8	20	4	260000	247000	240000
25000	4 7/8	24	4	285000	270000	250000

STANDARD SUPPORTS

Type P bus-supports with type R mounting and type F support—The bus clamp is of the two-bolt type and will accommodate bus straps of 2 inches to 5 inches wide, and connections of 1 1/2 inches to 4 1/2 inches. For 1 1/4 inch pipe mounting.

Style number includes bus-clamping bolts for 1 inch bus space and base for 1 1/4 inch pipe. Supports with greater bus space and with 3/4 inch and 2 inch pipe base can be supplied when ordered, except that supports having 4 7/8 inch diameter base require a pipe not less than 1 1/4 inch diameter.





SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Type P bus-supports with type R mounting and type R support—For bus rods, bus cable or bus tubes, up to 2½ inches diameter. For 1¼-inch pipe mounting.

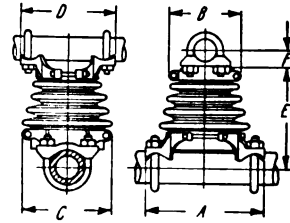


FIG. 9

Complete Support Style No.	Service Voltage	Outside Diameter of Bus, Inches	Diameter of Insulated Base, Inches	APPROXIMATE DIMENSIONS IN INCHES						Approx. Shipping Weight, Lbs.
				A	B	C	D	E	F	
238128	7500	Max. ¾	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	4 1/2	1 1/2	5
238129	7500	¾ to 1 1/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	4 1/2	1 1/2	5
238130	7500	1 1/8 to 1 3/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	4 1/2	1 1/2	5
238131	7500	1 3/8 to 1 7/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	4 1/2	1 1/2	5
238132	7500	Max. ¾	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	4 1/2	1 1/2	6
238133	7500	¾ to 1 1/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	4 1/2	1 1/2	6
238134	7500	1 1/8 to 1 3/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	4 1/2	1 1/2	6
238135	7500	1 3/8 to 1 7/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	4 1/2	1 1/2	6
238136	7500	1 7/8 to 1 3/4	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	5 1/2	1 1/2	8
238137	7500	1 3/4 to 1 7/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	5 1/2	1 1/2	8
238138	7500	1 7/8 to 2 1/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	5 1/2	1 1/2	8
238139	7500	2 1/8 to 2 1/2	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	5 1/2	1 1/2	8
238140	15000	Max. ¾	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	6 5/8	1 1/2	5
238141	15000	¾ to 1 1/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	6 5/8	1 1/2	5
238142	15000	1 1/8 to 1 3/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	6 5/8	1 1/2	5
238143	15000	1 3/8 to 1 7/8	2 7/8	4 1/2	3 3/4	4 1/2	4 1/2	6 5/8	1 1/2	5
238144	15000	Max. ¾	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	6 5/8	1 1/2	6
238145	15000	¾ to 1 1/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	6 5/8	1 1/2	6
238146	15000	1 1/8 to 1 3/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	6 5/8	1 1/2	6
238147	15000	1 3/8 to 1 7/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	6 5/8	1 1/2	6
238148	15000	1 7/8 to 1 3/4	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	6 5/8	1 1/2	8
238149	15000	1 3/4 to 1 7/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	6 5/8	1 1/2	8
238150	15000	1 7/8 to 2 1/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	6 5/8	1 1/2	8
238151	15000	2 1/8 to 2 1/2	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	6 5/8	1 1/2	8
238152	25000	Max. ¾	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	9	1 1/2	12
238153	25000	¾ to 1 1/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	9	1 1/2	12
238154	25000	1 1/8 to 1 3/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	9	1 1/2	12
238155	25000	1 3/8 to 1 7/8	3 7/8	5 1/2	4 1/8	5 1/2	4 1/2	9	1 1/2	12
238156	25000	1 7/8 to 1 3/4	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	9 1/2	1 1/2	17
238157	25000	1 3/4 to 1 7/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	9 1/2	1 1/2	17
238158	25000	1 7/8 to 2 1/8	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	9 1/2	1 1/2	17
238159	25000	2 1/8 to 2 1/2	4 7/8	7 1/2	5 1/8	6 1/2	5 1/2	9 1/2	1 1/2	17
238160	35000	Max. ¾	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	12 1/2	1 1/2	20
238161	35000	¾ to 1 1/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	12 1/2	1 1/2	20
238162	35000	1 1/8 to 1 3/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	12 1/2	1 1/2	20
238163	35000	1 3/8 to 1 7/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	12 1/2	1 1/2	20
238164	44000	Max. ¾	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238165	44000	¾ to 1 1/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238166	44000	1 1/8 to 1 3/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238167	44000	1 3/8 to 1 7/8	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	16 1/2	1 1/2	25

Type P bus-supports with type F mounting and type R support—For bus rods, bus cable or bus tubes, up to 2½ inches diameter.

All insulator supports listed on this page with diameter of insulator base 2 7/8 inches are for light duty, those having a diameter 3 7/8 inches are for medium duty; and those of 4 7/8 inches are for heavy duty.

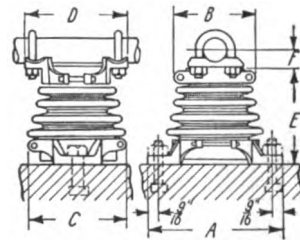


FIG. 10

Complete Support Style No.	Service Voltage	Outside Diameter of Bus, Inches	Diameter of Insulated Base, Inches	APPROXIMATE DIMENSIONS IN INCHES						Approx. Shipping Weight, Lbs.
				A	B	C	D	E	F	
238168	7500	Max. ¾	2 7/8	5 7/8	3 3/4	4 1/2	4 1/2	3 3/4	1 1/2	5
238169	7500	¾ to 1 1/8	2 7/8	5 7/8	3 3/4	4 1/2	4 1/2	3 3/4	1 1/2	5
238170	7500	1 1/8 to 1 3/8	2 7/8	5 7/8	3 3/4	4 1/2	4 1/2	3 3/4	1 1/2	5
238171	7500	1 3/8 to 1 7/8	2 7/8	5 7/8	3 3/4	4 1/2	4 1/2	3 3/4	1 1/2	5
238172	7500	Max. ¾	3 7/8	6 7/8	4 1/8	5	4 1/2	4 1/2	1 1/2	6
238173	7500	¾ to 1 1/8	3 7/8	6 7/8	4 1/8	5	4 1/2	4 1/2	1 1/2	6
238174	7500	1 1/8 to 1 3/8	3 7/8	6 7/8	4 1/8	5	4 1/2	4 1/2	1 1/2	6
238175	7500	1 3/8 to 1 7/8	3 7/8	6 7/8	4 1/8	5	4 1/2	4 1/2	1 1/2	6

Continued on following page

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Table for Figure 10—Continued

Complete Support Style No.	Service Voltage	Outside Diameter of Bus, Inches	Diameter of Insulated Base, Inches	APPROXIMATE DIMENSIONS IN INCHES						Approximate Shipping Weight, Lbs.
				A	B	C	D	E	F	
238176	7500	1 1/4 to 1 3/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	8
238177	7500	1 3/8 to 1 3/4	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	8
238178	7500	1 3/4 to 2 1/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	8
238179	7500	2 1/8 to 2 1/2	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	8
238180	15000	Max. 3/4	2 7/8	5 7/8	3 3/4	4 3/8	4 1/2	5 1/8	1 1/2	5
238181	15000	3/4 to 1 1/8	2 7/8	5 7/8	3 3/4	4 3/8	4 1/2	5 1/8	1 1/2	5
238182	15000	1 1/8 to 1 3/8	2 7/8	5 7/8	3 3/4	4 3/8	4 1/2	5 1/8	1 1/2	5
238183	15000	1 3/8 to 1 3/4	2 7/8	5 7/8	3 3/4	4 3/8	4 1/2	5 1/8	1 1/2	5
238184	15000	Max. 3/4	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	8
238185	15000	3/4 to 1 1/8	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	8
238186	15000	1 1/8 to 1 3/8	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	8
238187	15000	1 3/8 to 1 3/4	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	8
238188	15000	1 3/4 to 1 3/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	12
238189	15000	1 3/8 to 1 3/4	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	12
238190	15000	1 3/4 to 2 1/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	12
238191	15000	2 1/8 to 2 1/2	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	12
238192	25000	Max. 3/4	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	12
238193	25000	3/4 to 1 1/8	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	12
238194	25000	1 1/8 to 1 3/8	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	12
238195	25000	1 3/8 to 1 3/4	3 7/8	6 7/8	4 3/8	5	4 1/2	5 1/8	1 1/2	12
238196	25000	1 3/4 to 1 3/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	17
238197	25000	1 3/8 to 1 3/4	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	17
238198	25000	1 3/4 to 2 1/8	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	17
238199	25000	2 1/8 to 2 1/2	4 7/8	8 1/2	5 3/8	6 1/2	5 1/2	4 1/2	1 1/2	17
238200	35000	Max. 3/4	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	11 1/2	1 1/2	20
238201	35000	3/4 to 1 1/8	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	11 1/2	1 1/2	20
238202	35000	1 1/8 to 1 3/8	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	11 1/2	1 1/2	20
238203	35000	1 3/8 to 1 3/4	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	11 1/2	1 1/2	20
238204	44000	Max. 3/4	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238205	44000	3/4 to 1 1/8	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238206	44000	1 1/8 to 1 3/8	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	16 1/2	1 1/2	25
238207	44000	1 3/8 to 1 3/4	4 7/8	8 1/2	4 3/8	6 1/2	4 1/2	16 1/2	1 1/2	25

Type P bus-supports with type R mounting and type U support for 1 1/4-inch pipe mounting. Supports for 3/4-inch or 2-inch pipe base can be

supplied when ordered, except that supports having 4 7/8-inch diameter base require a pipe support not less than 1 1/4 inches diameter.

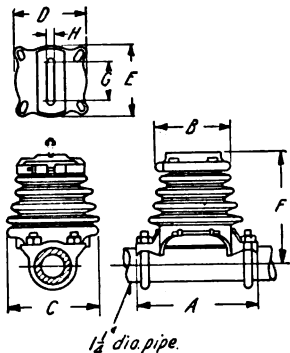


FIG. 11

Complete Support Style No.	Service Voltage	Diam. of Insulator Base, Inches	APPROXIMATE DIMENSIONS IN INCHES								Approx. Shipping Weight Pounds
			A	B	C	D	E	F	G	H	
238813	7500	2 7/8	4 1/2	3 5/8	4 1/8	2 7/8	2 7/8	5 1/2	1 1/2	3/8	5
238814	7500	3 7/8	5 1/2	4 3/4	5 1/8	3 1/2	3 5/8	5 1/2	1 1/2	3/8	6
238815	7500	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	4 1/2	6	2 1/2	3/8	8
238816	15000	2 7/8	4 1/2	3 5/8	4 1/8	2 7/8	2 7/8	6 1/2	1 1/2	3/8	5
238817	15000	3 7/8	5 1/2	4 3/8	5 1/8	3 1/2	3 5/8	6 1/2	1 1/2	3/8	8
238818	15000	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	4 1/2	7 1/2	2 1/2	3/8	12
238819	25000	3 7/8	5 1/2	4 3/8	5 1/8	3 1/2	3 5/8	9 1/2	1 1/2	3/8	17
238820	25000	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	4 1/2	10 1/2	2 1/2	3/8	12
238821	35000	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	4 1/2	13 1/2	1 1/2	3/8	20
238822	44000	4 7/8	7 1/2	4 7/8	6 1/2	4 1/2	4 1/2	17 1/2	1 1/2	3/8	25

All insulator supports listed on this page with diameter of insulator base 2 7/8 inches are for light duty; those having a diameter 3 7/8 inches are for medium duty, and those of 4 7/8 inches are for heavy duty.

Type P bus-support with type F mounting and type U support

Complete Support Style No.	Service Voltage	Diam. of Insulator Base, Inches	APPROXIMATE DIMENSIONS IN INCHES								Approx. Shipping Weight, Pounds
			A	B	C	D	E	F	G	H	
238823	7500	2 7/8	5 7/8	3 5/8	4 1/8	2 7/4	2 7/4	4 1/2	1 1/2	3/8	5
238824	7500	3 7/8	6 7/8	4 3/8	5	3 1/2	3 5/8	4 1/2	1 1/2	3/8	6
238825	7500	4 7/8	7 7/8	4 7/8	6 1/2	4 1/2	4 1/2	5 1/2	2 1/2	3/8	8
238826	15000	2 7/8	5 7/8	3 5/8	4 1/8	2 7/4	2 7/4	5 1/2	1 1/2	3/8	5
238827	15000	3 7/8	6 7/8	4 3/8	5	3 1/2	3 5/8	6 1/2	1 1/2	3/8	8
238828	15000	4 7/8	7 7/8	4 7/8	6 1/2	4 1/2	4 1/2	6 1/2	2 1/2	3/8	12
238829	25000	3 7/8	6 7/8	4 3/8	5	3 1/2	3 5/8	8 1/2	1 1/2	3/8	12
238830	25000	4 7/8	7 7/8	4 7/8	6 1/2	4 1/2	4 1/2	9 1/2	2 1/2	3/8	17
238831	35000	4 7/8	7 7/8	4 7/8	6 1/2	4 1/2	4 1/2	12 1/2	1 1/2	3/8	20
238832	44000	4 7/8	7 7/8	4 7/8	6 1/2	4 1/2	4 1/2	16 1/2	1 1/2	3/8	25

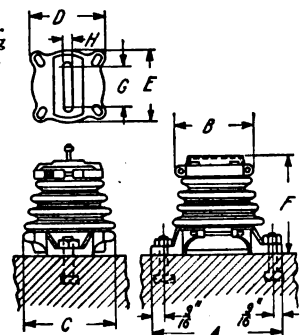


FIG. 12

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Type P bus-supports with type R mounting and type E support**—The bus-clamp is of the three-bolt clamp type and will accommodate bus-straps of 2 inches to 6 inches wide. For 1¼-inch pipe mounting.

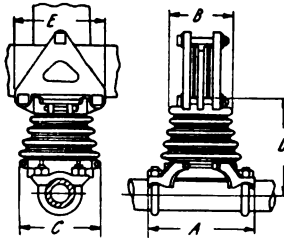


FIG. 13

Style number includes bus-clamping bolts for 1¼-inch bus space and base for 1¼-inch pipe. Supports with greater bus space and with ¾-inch or 2-inch pipe base can be supplied when ordered except that supports having 4⅞-inch base require a pipe support not less than 1¼ inches.

Complete Support Style No.	Service Voltage	Height of Bus, Inches	Diam. of Insulator Base, Inches	Approximate Dimensions in Inches					Approx. Shipping Wt., Lbs.
				A	B	C	D	E	
237804	7500	3	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	10
237805	7500	4	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	10
237806	7500	5	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	10
237807	7500	6	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	10
237808	7500	3	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	12
237809	7500	4	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	12
237810	7500	5	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	12
237811	7500	6	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	12
237812	15000	3	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	12
237813	15000	4	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	12
237814	15000	5	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	12
237815	15000	6	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	12
237816	15000	3	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	16
237817	15000	4	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	16
237818	15000	5	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	16
237819	15000	6	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	16
237820	25000	3	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	16
237821	25000	4	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	16
237822	25000	5	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	16
237823	25000	6	3 7/8	5 1/2	4 1/8	5 1/4	5 1/4	6 1/8	16
237824	25000	3	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	21
237825	25000	4	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	21
237826	25000	5	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	21
237827	25000	6	4 7/8	6 1/2	5 1/8	6 1/8	6 1/8	7 3/8	21

Complete Support Style No.	Service Voltage	Height of Bus, Inches	Diam. of Insulator Base, Inches	Approximate Dimensions in Inches					Approx. Shipping Wt., Lbs.
				A	B	C	D	E	
237496	7500	3	3 7/8	6 1/4	4 1/4	5	4 1/4	6 1/4	10
237497	7500	4	3 7/8	6 1/4	4 1/4	5	4 1/4	6 1/4	10
237498	7500	5	3 7/8	6 1/4	4 1/4	5	4 1/4	6 1/4	10
237499	7500	6	3 7/8	6 1/4	4 1/4	5	4 1/4	6 1/4	10
237500	7500	3	4 7/8	8 1/4	5	6 1/4	4 5/8	7 5/8	12
237501	7500	4	4 7/8	8 1/4	5	6 1/4	4 5/8	7 5/8	12
237502	7500	5	4 7/8	8 1/4	5	6 1/4	4 5/8	7 5/8	12
237503	7500	6	4 7/8	8 1/4	5	6 1/4	4 5/8	7 5/8	12
237504	15000	3	3 7/8	6 1/4	4 1/4	5	5 1/4	6 1/4	12
237505	15000	4	3 7/8	6 1/4	4 1/4	5	5 1/4	6 1/4	12
237506	15000	5	3 7/8	6 1/4	4 1/4	5	5 1/4	6 1/4	12
237507	15000	6	3 7/8	6 1/4	4 1/4	5	5 1/4	6 1/4	12
237508	15000	3	4 7/8	8 1/4	5	6 1/4	6	7 5/8	16
237509	15000	4	4 7/8	8 1/4	5	6 1/4	6	7 5/8	16
237510	15000	5	4 7/8	8 1/4	5	6 1/4	6	7 5/8	16
237511	15000	6	4 7/8	8 1/4	5	6 1/4	6	7 5/8	16
237512	25000	3	3 7/8	6 1/4	4 1/4	5	8 1/4	6 1/4	16
237513	25000	4	3 7/8	6 1/4	4 1/4	5	8 1/4	6 1/4	16
237514	25000	5	3 7/8	6 1/4	4 1/4	5	8 1/4	6 1/4	16
237515	25000	6	3 7/8	6 1/4	4 1/4	5	8 1/4	6 1/4	16
237516	25000	3	4 7/8	8 1/4	5	6 1/4	8 1/4	7 5/8	21
237517	25000	4	4 7/8	8 1/4	5	6 1/4	8 1/4	7 5/8	21
237518	25000	5	4 7/8	8 1/4	5	6 1/4	8 1/4	7 5/8	21
237519	25000	6	4 7/8	8 1/4	5	6 1/4	8 1/4	7 5/8	21

**Type P bus-supports with type F mounting and type E support**—The bus-clamp is of the three-bolt type and will accommodate bus-straps of 3 inches to 6 inches wide.

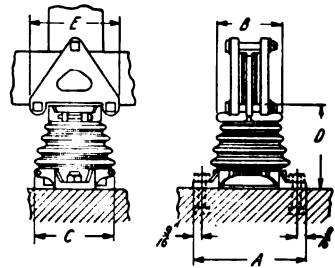


FIG. 14

Style number includes bus-clamping screw for 1¼-inch bus space. Supports with greater space supplied when ordered.

**Type P bus-supports with type R mounting and type E support**—The bus-clamp is of the four-bolt type and will accommodate bus-straps of 3 inches to 6 inches wide. For 1¼-inch pipe mounting.

Style number includes bus-clamping bolts for 1¼-inch bus space and base for 1¼-inch pipe. Supports with greater space and ¾-inch or 2-inch pipe base can be supplied when ordered, except that supports having 4⅞-inch base require pipe support not less than 1¼ inches.

All insulator supports listed on this page with diameter of insulator base 2⅞ inches are for light duty; those having a diameter 3⅞ inches are for medium duty, and those of 4⅞ inches are for heavy duty.

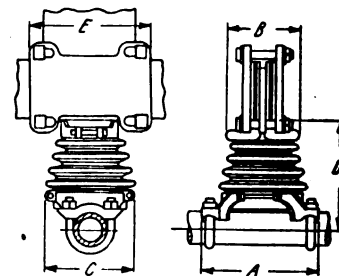


FIG. 15

See table on following page

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Table for Fig. 15

Complete Support Style No.	Service Voltage	Height of Bus, Inches	Diam. of Insulator Base, Inches	Approximate Dimensions in Inches					Approx. Shipping Weight, Lbs.
				A	B	C	D	E	
237828	7500	3	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	12	
237829	7500	4	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	12	
237830	7500	5	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	12	
237831	7500	6	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	12	
237832	7500	3	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	14	
237833	7500	4	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	14	
237834	7500	5	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	14	
237835	7500	6	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	14	
237836	15000	3	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	14	
237837	15000	4	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	14	
237838	15000	5	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	14	
237839	15000	6	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	14	
237840	15000	3	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	18	
237841	15000	4	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	18	
237842	15000	5	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	18	
237843	15000	6	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	18	
237844	25000	3	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	18	
237845	25000	4	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	18	
237846	25000	5	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	18	
237847	25000	6	3 7/8	4 1/8	5 1/8	5 1/8	6 1/8	18	
237848	25000	3	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	33	
237849	25000	4	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	33	
237850	25000	5	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	33	
237851	25000	6	4 7/8	5 7/8	6 3/8	6 3/8	7 3/8	33	

Type P bus-supports with type F mounting and type E support—The bus-clamp is of the four-bolt type and will accommodate bus-straps of 3 inches to 6 inches wide.

Style number includes bus-clamping bolts for 1 1/4 inch bus space. Supports with greater bus space can be supplied when ordered.

All insulator supports listed on this page with diameter of insulator base 2 7/8 inches are for light duty, those having a diameter 3 7/8 inches are for medium duty, and those of 4 7/8 inches are for heavy duty.

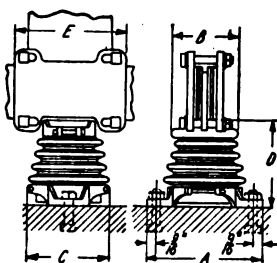


FIG. 17

Complete Support Style No.	Service Voltage	Height of Bus, Inches	Diam. of Insulator Base, Inches	Approximate Dimensions in Inches					Approx. Shipping Weight, Lbs.
				A	B	C	D	E	
237545	7500	3	3 7/8	6 7/8	4 1/8	5	4 1/8	6 1/8	12
237546	7500	4	3 7/8	6 7/8	4 1/8	5	4 1/8	6 1/8	12
237547	7500	5	3 7/8	6 7/8	4 1/8	5	4 1/8	6 1/8	12
237548	7500	6	3 7/8	6 7/8	4 1/8	5	4 1/8	6 1/8	12
237549	7500	3	4 7/8	8 1/8	5	6 1/2	4 5/8	7 3/8	14
237550	7500	4	4 7/8	8 1/8	5	6 1/2	4 5/8	7 3/8	14
237551	7500	5	4 7/8	8 1/8	5	6 1/2	4 5/8	7 3/8	14
237552	7500	6	4 7/8	8 1/8	5	6 1/2	4 5/8	7 3/8	14
237553	15000	3	3 7/8	6 7/8	4 1/8	5	5 1/8	6 1/8	14
237554	15000	4	3 7/8	6 7/8	4 1/8	5	5 1/8	6 1/8	14
237555	15000	5	3 7/8	6 7/8	4 1/8	5	5 1/8	6 1/8	14
237556	15000	6	3 7/8	6 7/8	4 1/8	5	5 1/8	6 1/8	14
237557	15000	3	4 7/8	8 1/8	5	6 1/2	6	7 3/8	18
237558	15000	4	4 7/8	8 1/8	5	6 1/2	6	7 3/8	18
237559	15000	5	4 7/8	8 1/8	5	6 1/2	6	7 3/8	18
237560	15000	6	4 7/8	8 1/8	5	6 1/2	6	7 3/8	18
237561	25000	3	3 7/8	6 7/8	4 1/8	5	8 1/8	6 1/8	18
237562	25000	4	3 7/8	6 7/8	4 1/8	5	8 1/8	6 1/8	18
237563	25000	5	3 7/8	6 7/8	4 1/8	5	8 1/8	6 1/8	18
237564	25000	6	3 7/8	6 7/8	4 1/8	5	8 1/8	6 1/8	18
237565	25000	3	4 7/8	8 1/8	5	6 1/2	8 3/4	7 3/8	33
237566	25000	4	4 7/8	8 1/8	5	6 1/2	8 3/4	7 3/8	33
237567	25000	5	4 7/8	8 1/8	5	6 1/2	8 3/4	7 3/8	33
237568	25000	6	4 7/8	8 1/8	5	6 1/2	8 3/4	7 3/8	33

Type P bus-supports with type R mounting and type E-1 support, for vertical bus-straps of light capacity only. For 1 1/4-inch pipe mounting.

Style number includes base supports for 1 1/4-inch pipe. Supports with 3/4-inch or 2-inch pipe base supplied when ordered, except that supports having 4 7/8-inch diameter base, require a pipe support not less than 1 1/4-inch. Bus rests in the support but is not clamped in it. These supports may be applied when the station capacity does not exceed 5000 kv-a.

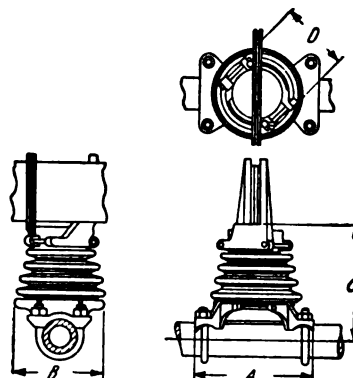


FIG. 16

Complete Support Style No.	Service Voltage	Diam. of Insulator Base, Inches	DIMENSIONS IN INCHES				Approx. Shipping Weight, Pounds
			A	B	C	D	
238117	7500	2 7/8	4 1/8	4 3/8	4 3/8	3 3/8	5
238118	7500	2 7/8	5 1/8	5 1/8	4 3/8	4 3/8	6
238119	15000	3 7/8	4 1/8	4 1/8	6	3 3/8	5
238120	15000	3 7/8	5 1/8	5 1/8	6 1/8	4 3/8	8
238121	25000	4 7/8	5 1/8	5 1/8	9 3/8	4 3/8	12
238122	35000	4 7/8	7 1/8	7 1/8	12 3/8	4 3/8	20
238123	44000	4 7/8	7 1/8	7 1/8	17 3/8	4 3/8	25

Type P bus-supports with type F mounting and type E-1 support, for vertical bus-straps. Bus rests in the support but is not clamped in it. These supports may be applied when station capacity does not exceed 5000 kv-a.

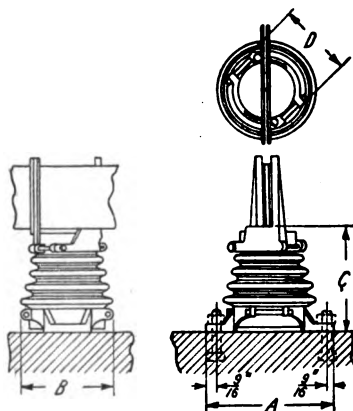


FIG. 18

See table on following page

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Table for Fig. 18

Complete Support Style No.	Service Voltage	Diameter of Insulator Base, Inches	APPROXIMATE DIMENSIONS IN INCHES				Approx. Shipping Weight, Lbs.
			A	B	C	D	
238110	7500	2 7/8	5 1/8	4 1/8	3 1/2	3 3/4	5
238111	7500	3 1/8	6 1/8	5	4 1/8	4 1/4	6
238112	15000	2 7/8	5 1/8	4 1/8	5 1/8	3 3/4	5
238113	15000	3 1/8	6 1/8	5	5 1/8	4 1/4	8
238114	25000	3 1/8	6 1/8	5	8 1/4	4 1/4	12
238115	35000	4 1/8	8 1/8	6 1/2	12	4 1/4	20
238116	44000	4 7/8	8 1/8	6 1/2	16 1/8	4 1/4	25

Type P bus-supports with type R mounting and type F support—The bus-clamp is of the four-bolt type and will accommodate bus straps of 3 inches to 6 inches wide and connections of 4 1/2 inches and 6 inches. For 1 1/4-inch pipe mounting.

Style number includes bus-clamping bolt for 1 inch bus space and base for 1 1/4-inch pipe. Supports with greater bus space and for 3/4-inch or 2-inch pipe base can be supplied when ordered, except that supports having 4 7/8-inch diameter base require a pipe support not less than 1 1/4-inch diameter.

All insulator supports listed on this page with diameter of insulator base 2 7/8 inches are for light duty; those having a diameter 3 1/8 inches are for medium duty, and those of 4 7/8 inches are for heavy duty.

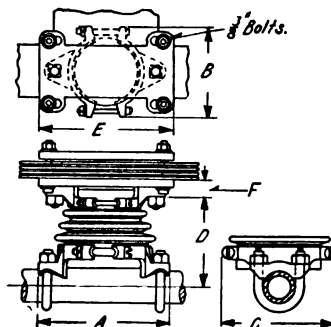


FIG. 19

Complete Support Style No.	Service Voltage	Width of Bus, Inches	Width of Connectors, Inches	Diameter of Insulator, Inches	DIMENSIONS IN INCHES						Approx. Shipping Weight, Lbs.
					A	B	C	D	E	F	
238636	7500	3	4 1/4	3 7/8	5 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	12
238637	7500	4	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	12
238638	7500	5	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	12
238639	7500	6	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	12
238640	7500	3	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	14
238641	7500	4	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	14
238642	7500	5	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	14
238643	7500	6	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	14
238644	15000	3	4 1/4	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	14
238645	15000	4	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	14
238646	15000	5	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	14
238647	15000	6	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	14
238648	15000	3	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	18
238649	15000	4	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	18
238650	15000	5	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	18
238651	15000	6	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	18
238652	25000	3	4 1/4	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	18
238653	25000	4	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	18
238654	25000	5	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	18
238655	25000	6	4 1/2	3 3/8	4 1/8	4 1/8	5 1/8	5	6 1/8	5 3/8	18
238656	25000	3	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	33
238657	25000	4	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	33
238658	25000	5	6	4 1/8	5	5	6 1/2	5 1/2	7 1/8	5 3/8	33
238659	25000	6	6	4 7/8	7	7	6 1/2	9 1/2	7 3/8	7 3/8	33

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Type P bus-supports with type F mounting and type F support**—The bus-clamp is of the four-bolt type and will accommodate bus straps of 3 inches to 6 inches wide, and connections of 4½ inches and 6 inches.

**Style number** includes bus-clamping bolt for 1-inch bus space.

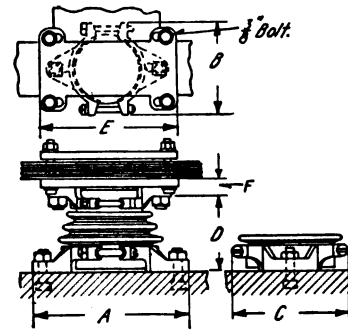


FIG. 20

Complete Support Style No.	Service Voltage	Width of Bus, Inches	Width of Connectors, Inches	Diam. of Insulator Base, Inches	APPROXIMATE DIMENSIONS IN INCHES						Approx. Shipping Weight Lbs.
					A	B	C	D	E	F	
238660	7500	3	4½	3⅞	6⅞	4½	5	4½	6½	5½	9½
238661	7500	4	4½	3⅞	6⅞	4½	5	4½	6½	5½	13
238662	7500	5	4½	3⅞	6⅞	4½	5	4½	6½	5½	13
238663	7500	6	4½	3⅞	6⅞	4½	5	4½	6½	5½	13
238664	7500	3	6	4⅞	8⅞	5	6½	4½	7½	5½	14
238665	7500	4	6	4⅞	8⅞	5	6½	4½	7½	5½	17
238666	7500	5	6	4⅞	8⅞	5	6½	4½	7½	5½	17
238667	7500	6	6	4⅞	8⅞	5	6½	4½	7½	5½	19
238668	15000	3	4½	3⅞	6⅞	4½	5	5½	6½	5½	10
238669	15000	4	4½	3⅞	6⅞	4½	5	5½	6½	5½	13
238670	15000	5	4½	3⅞	6⅞	4½	5	5½	6½	5½	14
238671	15000	6	4½	3⅞	6⅞	4½	5	5½	6½	5½	15
238672	15000	3	6	4⅞	8⅞	5	6½	5½	7½	5½	15
238673	15000	4	6	4⅞	8⅞	5	6½	5½	7½	5½	18
238674	15000	5	6	4⅞	8⅞	5	6½	5½	7½	5½	19
238675	15000	6	6	4⅞	8⅞	5	6½	5½	7½	5½	20
238676	25000	3	4½	3⅞	6⅞	4½	5	8¼	6½	5½	13
238677	25000	4	4½	3⅞	6⅞	4½	5	8¼	6½	5½	16
238678	25000	5	4½	3⅞	6⅞	4½	5	8¼	6½	5½	17
238679	25000	6	4½	3⅞	6⅞	4½	5	8¼	6½	5½	18
238680	25000	3	6	4⅞	8⅞	5	6½	8¾	7½	5½	18
238681	25000	4	6	4⅞	8⅞	5	6½	8¾	7½	5½	21
238682	25000	5	6	4⅞	8⅞	5	6½	8¾	7½	5½	22
238683	25000	6	6	4⅞	8⅞	5	6½	8¾	7½	5½	23

Corrugated porcelain insulators, parts of bus-bar supports listed and illustrated on previous pages.

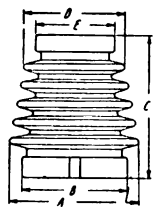


FIG. 21

Porcelain Insulator Style No.	Maximum Service Voltage	APPROXIMATE DIMENSIONS IN INCHES					Number Rings	Approx. Shipping Weight, Lbs.
		A	B	C	D	E		
242000	7500	5¾	4⅞	4⅞	4¾	3⅞	3	2
242001	7500	4¾	3⅞	3⅞	3¾	2⅞	3	2
242002	7500	3¾	2⅞	3⅞	3¼	2⅞	3	3
242003	15000	5¾	4⅞	5⅞	4¾	3⅞	5	2
242004	15000	4¾	3⅞	5¼	3¾	2⅞	5	4
242005	15000	3¾	2⅞	5	3¼	2¾	5	5
242006	25000	4¾	3⅞	8	3¾	2⅞	9	8
242008	25000	5¾	4⅞	8⅞	4¾	3⅞	9	12
242007	35000	5¾	4⅞	11¼	3¾	2⅞	14	16
242006	44000	5¾	4⅞	15⅞	3¾	2⅞	20	20

**Type P bus-bar support, rear-connected**—Figs. 22 and 23 show rear-connected type P bus-bar supports. If rear-connected supports are to be used with front-connected supports, give cross reference in ordering, to insure that the two sets match.

**Style Number** includes support complete without contact nuts and mounting blocks. See Fig. 27.

All insulator supports listed on this page with diameter of insulator base 2⅞ inches are for light duty; those having a diameter of 3⅞ inches are for medium duty, and those of 4⅞ inches are for heavy duty.

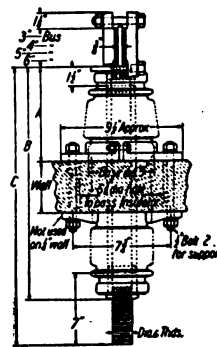


FIG. 22

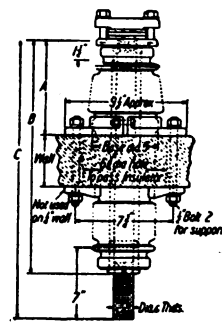


FIG. 23

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**TYPE P BUS-BAR SUPPORTS, REAR-CONNECTED  
WITH 3 TO 6-INCH TYPE E BUS CLAMPS**

**With 5-Inch Base**

Amperes	Width of Busses Inches	Style No.	Amperes	Width of Busses Inches	Style No.
<b>For 7500 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288348	400	5	288358
600	3	288349	600	5	288359
1200	3	288350	1200	5	288360
1600	3	288351	1600	5	288361
2000	3	288352	2000	5	288362
400	4	288353	400	6	288363
600	4	288354	600	6	288364
1200	4	288355	1200	6	288365
1600	4	288356	1600	6	288366
2000	4	288357	2000	6	288367
<b>Thickness of Wall, 4 Inches</b>					
400	3	288368	400	5	288378
600	3	288369	600	5	288379
1200	3	288370	1200	5	288380
1600	3	288371	1600	5	288381
2000	3	288372	2000	5	288382
400	4	288373	400	6	288383
600	4	288374	600	6	288384
1200	4	288375	1200	6	288385
1600	4	288376	1600	6	288386
2000	4	288377	2000	6	288387

<b>For 15,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288388	400	5	288398
600	3	288389	600	5	288399
1200	3	288390	1200	5	288400
1600	3	288391	1600	5	288401
2000	3	288392	2000	5	288402
400	4	288393	400	6	288403
600	4	288394	600	6	288404
1200	4	288395	1200	6	288405
1600	4	288396	1600	6	288406
2000	4	288397	2000	6	288407
<b>Thickness of Wall, 4 Inches</b>					
400	3	288408	400	5	288418
600	3	288409	600	5	288419
1200	3	288410	1200	5	288420
1600	3	288411	1600	5	288421
2000	3	288412	2000	5	288422
400	4	288413	400	6	288423
600	4	288414	600	6	288424
1200	4	288415	1200	6	288425
1600	4	288416	1600	6	288426
2000	4	288417	2000	6	288427

<b>For 25,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	291520	400	5	291530
600	3	291521	600	5	291531
1200	3	291522	1200	5	291532
1600	3	291523	1600	5	291533
2000	3	291524	2000	5	291534
400	4	291525	400	6	291535
600	4	291526	600	6	291536
1200	4	291527	1200	6	291537
1600	4	291528	1600	6	291538
2000	4	291529	2000	6	291539
<b>Thickness of Wall, 4 Inches</b>					
400	3	291540	400	5	291550
600	3	291541	600	5	291551
1200	3	291542	1200	5	291552
1600	3	291543	1600	5	291553
2000	3	291544	2000	5	291554
400	4	291545	400	6	291555
600	4	291546	600	6	291556
1200	4	291547	1200	6	291557
1600	4	291548	1600	6	291558
2000	4	291549	2000	6	291559

**With 4-Inch Base**

<b>For 7500 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288444	600	3	288448
400	4	288445	600	4	288449
<b>Thickness of Wall, 4 Inches</b>					
400	3	288446	600	3	288450
400	4	288447	600	4	288451
<b>For 15,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288452	600	3	288456
400	4	288453	600	4	288457
<b>Thickness of Wall, 4 Inches</b>					
400	3	288454	600	3	288458
400	4	288455	600	4	288459

Order by Style Number



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**TYPE P BUS-BAR SUPPORTS, REAR-CONNECTED  
WITH 3 TO 6-INCH TYPE F BUS CLAMPS**

**With 5-Inch Base**

Amperes	Width of Busses Inches	Style No.	Amperes	Width of Busses Inches	Style No.
<b>For 7500 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	287630	400	5	287640
600	3	287631	600	5	287641
1200	3	287632	1200	5	287642
1600	3	287633	1600	5	287643
2000	3	287634	2000	5	287644
400	4	287635	400	6	287645
600	4	287636	600	6	287646
1200	4	287637	1200	6	287647
1600	4	287638	1600	6	287648
2000	4	287639	2000	6	287649
<b>Thickness of Wall, 4 Inches</b>					
400	3	287650	400	5	287660
600	3	287651	600	5	287661
1200	3	287652	1200	5	287662
1600	3	287653	1600	5	287663
2000	3	287654	2000	5	287664
400	4	287655	400	6	287665
600	4	287656	600	6	287666
1200	4	287657	1200	6	287667
1600	4	287658	1600	6	287668
2000	4	287659	2000	6	287669
<b>For 15,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	287670	400	5	287680
600	3	287671	600	5	287681
1200	3	287672	1200	5	287682
1600	3	287673	1600	5	287683
2000	3	287674	2000	5	287684
400	4	287675	400	6	287685
600	4	287676	600	6	287686
1200	4	287677	1200	6	287687
1600	4	287678	1600	6	287688
2000	4	287679	2000	6	287689
<b>Thickness of Wall, 4 Inches</b>					
400	3	287690	400	5	287700
600	3	287691	600	5	287701
1200	3	287692	1200	5	287702
1600	3	287693	1600	5	287703
2000	3	287694	2000	5	287704
400	4	287695	400	6	287705
600	4	287696	600	6	287706
1200	4	287697	1200	6	287707
1600	4	287698	1600	6	287708
2000	4	287699	2000	6	287709
<b>For 25,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	291806	400	5	291816
600	3	291807	600	5	291817
1200	3	291808	1200	5	291818
1600	3	291809	1600	5	291819
2000	3	291810	2000	5	291820
400	4	291811	400	6	291821
600	4	291812	600	6	291822
1200	4	291813	1200	6	291823
1600	4	291814	1600	6	291824
2000	4	291815	2000	6	291825
<b>Thickness of Wall, 4 Inches</b>					
400	3	291827	400	5	291837
600	3	291828	600	5	291838
1200	3	291829	1200	5	291839
1600	3	291830	1600	5	291840
2000	3	291831	2000	5	291841
400	4	291832	400	6	291842
600	4	291833	600	6	291843
1200	4	291834	1200	6	291844
1600	4	291835	1600	6	291845
2000	4	291836	2000	6	291846

**With 4-Inch Base**

<b>For 7500 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288428	600	3	288432
400	4	288429	600	4	288433
<b>Thickness of Wall, 4 Inches</b>					
400	3	288430	600	3	288434
400	4	288431	600	4	288435
<b>For 15,000 Volts</b>					
<b>Thickness of Wall, 1/4 Inch</b>					
400	3	288436	600	3	288440
400	4	288437	600	4	288441
<b>Thickness of Wall, 4 Inches</b>					
400	3	288438	600	3	288442
400	4	288439	600	4	288443

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Corrugated porcelain insulator, for rear-connected bus-bar supports.

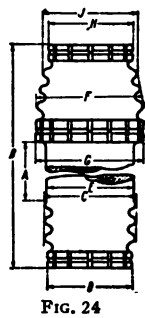


FIG. 24

Porcelain Insulator Style No.	Maximum Service Voltage	Thick-ness of Wall or Base Inches	DIMENSIONS IN INCHES								Approx. Shipping Weight Lbs.	
			A	B	C	D	E	F	G	H		J
238801	7500	1/4	1 1/4	7 3/4	3 1/2	2 7/8	3	3 1/4	3 7/8	2 7/8	3 3/8	15
238802	7500	4	5 1/4	11 1/4	3 3/8	2 7/8	3	3 3/4	3 7/8	2 7/8	3 3/8	15
238803	7500	1/4	1 1/4	8 1/4	4 1/8	3 1/8	4	4 1/4	4 1/8	3 3/8	4 1/8	15
238804	7500	4	5 1/4	12 1/4	4 1/8	3 1/8	4	4 1/4	4 1/8	3 3/8	4 1/8	18
238805	15000	1/4	1 1/4	10 3/4	3 3/8	2 7/8	3	3 3/4	3 7/8	2 7/8	3 3/8	18
238806	15000	4	5 1/4	14 1/4	3 3/8	2 7/8	3	3 3/4	3 7/8	2 7/8	3 3/8	18
238807	15000	1/4	1 1/4	15 1/4	4 1/8	3 3/8	4	4 1/4	4 1/8	3 3/8	4 1/8	18
238808	15000	4	5 1/4	19 1/4	4 1/8	3 3/8	4	4 1/4	4 1/8	3 3/8	4 1/8	20
238809	25000	1/4	1 1/4	16 3/4	3 3/8	2 7/8	3	3 3/4	3 7/8	2 7/8	3 3/8	20
238810	25000	4	5 1/4	20 1/4	3 3/8	2 7/8	3	3 3/4	3 7/8	2 7/8	3 3/8	20
238811	25000	1/4	1 1/4	16 3/4	4 1/8	3 3/8	4	4 1/4	4 1/8	3 3/8	4 1/8	20
238812	25000	4	5 1/4	20 1/4	4 1/8	3 3/8	4	4 1/4	4 1/8	3 3/8	4 1/8	20

TYPE S BUS-BAR SUPPORTS

A heavy duty bus-bar support available for kv-a. ratings above those given on page 438.

The insulators are porcelain and made by wet or cast process and have a brown mahogany glaze. They are corrugated to assure ample creepage surface under service conditions.

The supports are of the interchangeable unit type with top and bottom castings cemented to the insulator.

The top casting, (Figs. 24F and 24G) is designed to allow bolting to it suitable fittings for supporting strap busses 3, 4, 5 or 6 inches wide either flat or on edge.

The bottom casting is suitable for mounting on a flat surface. By adding fitting shown in Fig. 24C

these insulator supports are adapted to pipe frame mounting.

For adjusting the height of the support when lining up in a long bus structure, the adjustable feature for the base as shown in Fig. 24B can be supplied.

These insulators can also be used for supporting one or two cables by the use of top fitting as shown in Fig. 24A.

Type S bus-bar supports are available in both the front and rear-connected types. The insulator units used with both types of supports are interchangeable with the insulator units used with the heavy-duty type S front and rear-connected disconnecting switches.

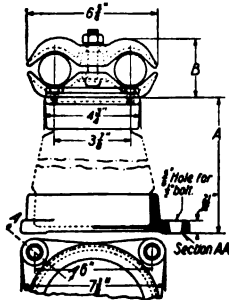
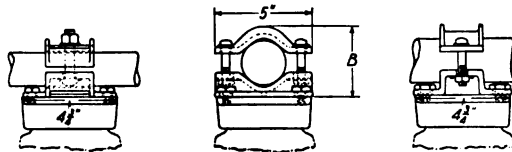


FIG. 24A



A = 7 3/4" for 15,000 Volts  
 = 10 3/4" for 25,000 Volts  
 B = 3 1/2" Approx. for 1 3/4" to 2 1/4" inch diameter Cable  
 = 4 1/2" Approx. for 2 1/2" to 3" inch diameter Cable

Section A-A showing adjustment when ordered.  
 Bolt  
 1/2" Drill 4 top 4 holes in base 1/4" dia per inch for adjusting sleeves.

FIG. 24B

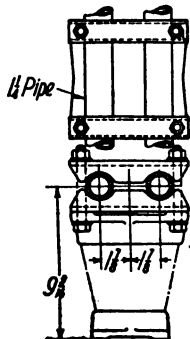


FIG. 24C

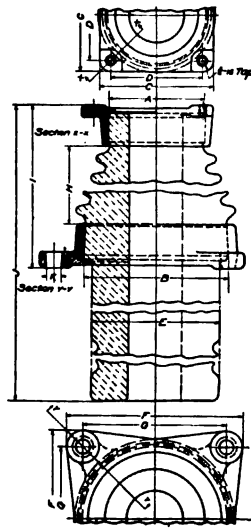


FIG. 24D

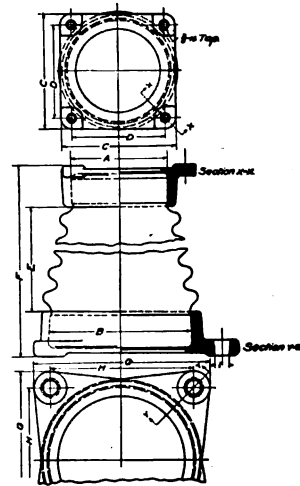


FIG. 24E

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Type S Corrugated Porcelain Insulator Units, for Front-Connected Bus-Bar Supports

Table for Fig. 24E

Insulator with Fittings Style No.	Service Voltage	No. of Corrugations	POUNDS STRENGTH		APPROXIMATE DIMENSIONS IN INCHES									Approx. Ship. Wt., Lbs.
			Cantilever	Tensile	A	B	C	D	E	F	G	H	I	
295810	7500	3	1500	3000	4	5	4 3/4	3 3/8	2 1/4	5 3/8	6 3/8	5 1/8	1 1/2	16
295811	15000	5	1200	3000	4	5	4 3/4	3 3/8	4 1/4	7 3/8	6 3/8	5 1/8	1 1/2	19
295812	15000	5	2000	3000	4	6	4 3/4	3 3/8	4 1/4	7 3/8	7 3/8	6	1 1/2	22
295814	25000	7	1500	3000	4	6	4 3/4	3 3/8	7	10 3/8	7 3/8	6	1 1/2	25

Type S Corrugated Porcelain Insulator Units, for Rear-Connected Bus-Bar Supports

Table for Fig. 24D

Insulator with Fittings Style No.	Service Voltage	Thick-ness of Wall	LBS. STRENGTH		No. of Corrugations	APPROXIMATE DIMENSIONS IN INCHES											Approx. Shipping Wt., Lbs.
			Cantilever	Tensile		A	B	C	D	E	F	G	H	I	J	K	
297237	7500	1/4	1500	3000	3	4	5	4 3/4	3 3/8	4 3/8	6 3/8	5 1/8	2 1/4	5 3/8	10 1/2	1 1/2	22
297238	7500	1/4	1500	3000	3	4	5	4 3/4	3 3/8	4 3/8	6 3/8	5 1/8	2 1/4	5 3/8	15 1/2	1 1/2	29
297241	15000	1/4	1200	3000	5	4	5	4 3/4	3 3/8	4 3/8	6 3/8	5 1/8	4 1/4	7 3/8	14 1/2	1 1/2	26
297242	15000	1/4	1200	3000	5	4	5	4 3/4	3 3/8	4 3/8	6 3/8	5 1/8	4 1/4	7 3/8	19 1/2	1 1/2	33
305636	15000	1/4	2000	3000	5	4	6	4 3/4	3 3/8	5 3/8	7 3/8	6	4 1/4	7 3/8	14 1/2	1 1/2	32
305637	15000	1/4	2000	3000	5	4	6	4 3/4	3 3/8	5 3/8	7 3/8	6	4 1/4	7 3/8	19 1/2	1 1/2	41
297233	25000	1/4	1500	3000	7	4	6	4 3/4	3 3/8	5 3/8	7 3/8	6	7	10 3/8	19 1/2	1 1/2	37
297234	25000	1/4	1500	3000	7	4	6	4 3/4	3 3/8	5 3/8	7 3/8	6	7	10 3/8	24 1/2	1 1/2	46

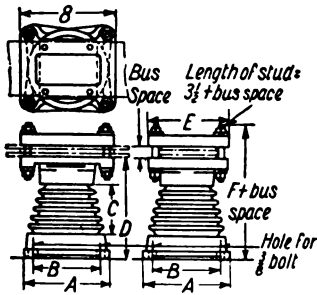


FIG. 24F

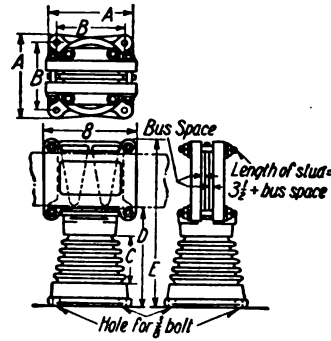


FIG. 24G

Type S Front-Connected Bus-Bar Supports 7500 to 25,000 Volts, Horizontal Mounting

Table for Fig. 24F

Complete Support Style No.	Service Voltage	Insulator Unit Style No.	Width of Bus Inches	APPROXIMATE DIMENSIONS IN INCHES						Approx. Shipping Wt., Lbs.
				A	B	C	D	E	F	
321887	7500	295810	3	6 3/8	5 1/8	2 1/4	6 3/8	5	8 1/8	26
321888	7500	295810	4	6 3/8	5 1/8	2 1/4	6 3/8	6	8 1/8	29
321889	7500	295810	5	6 3/8	5 1/8	2 1/4	6 3/8	7	8 1/8	32
321890	7500	295810	6	6 3/8	5 1/8	2 1/4	6 3/8	8	8 1/8	35
321891	15000	295811	3	6 3/8	5 1/8	4 1/4	8 3/8	5	10 3/8	29
321892	15000	295811	4	6 3/8	5 1/8	4 1/4	8 3/8	6	10 3/8	32
321893	15000	295811	5	6 3/8	5 1/8	4 1/4	8 3/8	7	10 3/8	35
321894	15000	295811	6	6 3/8	5 1/8	4 1/4	8 3/8	8	10 3/8	38
321895	15000	295812	3	7 3/8	6	4 1/4	8 3/8	5	10 3/8	32
321896	15000	295812	4	7 3/8	6	4 1/4	8 3/8	6	10 3/8	35
321897	15000	295812	5	7 3/8	6	4 1/4	8 3/8	7	10 3/8	38
321898	15000	295812	6	7 3/8	6	4 1/4	8 3/8	8	10 3/8	41
321899	25000	295814	3	7 3/8	6	7	11 3/8	5	12 3/8	36
321900	25000	295814	4	7 3/8	6	7	11 3/8	6	12 3/8	39
321901	25000	295814	5	7 3/8	6	7	11 3/8	7	13 3/8	42
321902	25000	295814	6	7 3/8	6	7	11 3/8	8	13 3/8	45

Type S Front-Connected Bus-Bar Supports 7500 to 25,000 Volts, Vertical Mounting

Table for Fig. 24G

Complete Support Style No.	Service Voltage	Insulator Unit Style No.	Width of Bus Inches	APPROXIMATE DIMENSIONS IN INCHES					Approx. Shipping Wt., Lbs.
				A	B	C	D	E	
321795	7500	295810	3	6 3/8	5 1/8	2 1/4	6 3/8	10 3/8	31
321796	7500	295810	4	6 3/8	5 1/8	2 1/4	6 3/8	11 3/8	35
321797	7500	295810	5	6 3/8	5 1/8	2 1/4	6 3/8	12 3/8	40
321798	7500	295810	6	6 3/8	5 1/8	2 1/4	6 3/8	13 3/8	44
321799	15000	295811	3	6 3/8	5 1/8	4 1/4	8 3/8	12 3/8	34
321800	15000	295811	4	6 3/8	5 1/8	4 1/4	8 3/8	13 3/8	38
321801	15000	295811	5	6 3/8	5 1/8	4 1/4	8 3/8	14 3/8	43
321802	15000	295811	6	6 3/8	5 1/8	4 1/4	8 3/8	15 3/8	47
321803	15000	295812	3	7 3/8	6	4 1/4	8 3/8	12 3/8	37
321804	15000	295812	4	7 3/8	6	4 1/4	8 3/8	13 3/8	41
321805	15000	295812	5	7 3/8	6	4 1/4	8 3/8	14 3/8	46
321806	15000	295812	6	7 3/8	6	4 1/4	8 3/8	15 3/8	50
321807	25000	295814	3	7 3/8	6	7	11 3/8	15 3/8	41
321808	25000	295814	4	7 3/8	6	7	11 3/8	16 3/8	45
321809	25000	295814	5	7 3/8	6	7	11 3/8	17 3/8	50
321810	25000	295814	6	7 3/8	6	7	11 3/8	18 3/8	54

Order by Style Number









SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

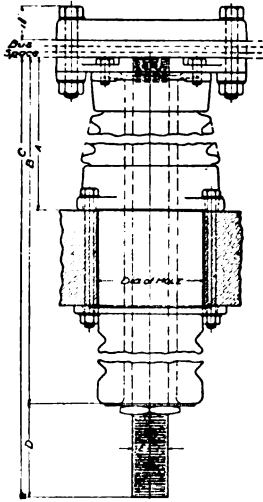


FIG. 24H

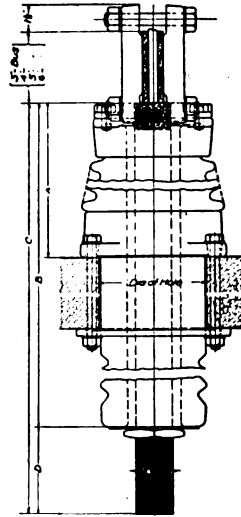


FIG. 24I

Bus-strap brackets for 4 to 10 inch bus, low tension, 600 volts maximum, heavy capacity, frame mounting. This bracket is designed to carry very heavy busses; it consists of a slate slab for the rider and slate blocks for the spacers. A separate set of riders and spacers is required for each bus.

The bracket is designed to be supported on a flat surface, such as the top side of a horizontal angle. The style number includes all necessary parts for one complete bracket, except the supporting angle.

Style No	DIMENSIONS IN INCHES		Approx Shipping Weight, Lbs.
	A	B	
164253	4	2	10
164254	6	2	10
164255	8	2	12
164256	10	2	12
164257	4	4	12
164258	6	4	12
164259	8	4	14
164260	10	4	14

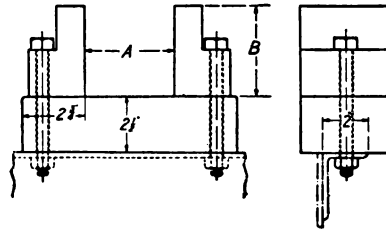


FIG. 25

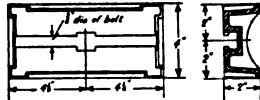
Order by Style Number



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Universal mounting block for post-type bus-supports, front-connected.—Fig. 26 shows a useful arrangement for mounting the corrugated, insulated

post-type bus-support to wall. The mounting block should be built into the wall, of concrete or brick, during construction, making a handy mounting for the supports, as the mounting bolts may be placed in position later.



Style No. 247235

Description Cast iron universal mounting block, without mounting bolts.

FIG. 26

Mounting blocks for rear-connected supports (Fig. 27) make a convenient mounting for the supports, as all that is necessary to mount the support is to bolt it to studs already in place. The blocks

are of suitable dimensions for building in brick or concrete wall. Insulators may be removed from the wall without disturbing the bus or breaking out the blocks.

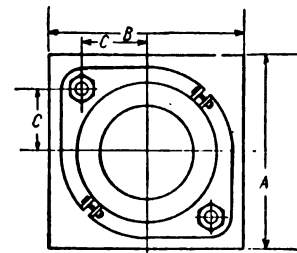


FIG. 27

Style No.	DIMENSIONS IN INCHES				
	Diam. Ins. Base	Thickness of Wall	A	B	C
291009	5	4	8 1/4	8 1/4	2 3/4
291011	4	4	8 1/4	8 1/4	2 1/4
291010	5	8 1/4	12 1/2	12 1/2	2 3/4
291012	4	8 1/4	12 1/2	12 1/2	2 1/4

Bus-strap support with plain insulator for 3500 volts maximum service consists of dry process porcelain insulator with necessary iron fittings and are suitable for light or medium weight service, with 1/2 inch to 2 1/2 inches bus space for flat mounting. Bus is supported in place but is not clamped.

Ampere capacity for D-C. busses limited only by bus space available. Ampere capacity for A-C. busses limited to 10,000 amperes maximum, symmetrical short-circuit current.

Style number includes one bus support complete with mounting details.

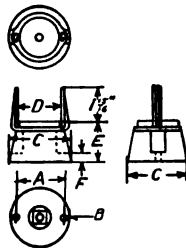


FIG. 28

Bus-Strap Support Style No.	Max. Service Voltage	APPROXIMATE DIMENSIONS IN INCHES						Approx. Shipping Weight Lbs.
		A	B	C	D	E	F	
238470	3500	1 7/8	1/4	2 1/2	1 1/2	2 1/4	3/8	2
238471	3500	2 3/4	1/4	3 1/2	2 1/2	2 1/4	1/2	2

Bus-bar brackets with plain insulators, for 3500 volts maximum service. These brackets are made of cast iron and consist of a number of individual supports as given in table and described more fully above. Bus is supported in place but is not clamped.

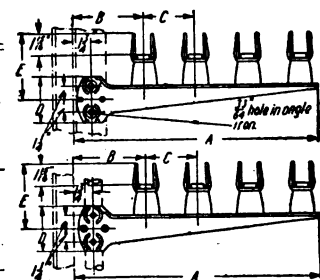
Ampere capacity for A-C. busses limited to 10,000 amperes maximum, symmetrical short-circuit current.

Style number includes one bracket complete with supports and mounting bolts.

Ampere capacity for D-C. busses limited only by bus space available.

Bus-Bar Bracket Style No.	Individual Insulator Style No.	Number of Support	Max. Service Voltage	Type of Frame	*DIMENSIONS IN INCHES					Approx. Shipping Weight Lbs.
					A	B	C	D	E	
240191	238470	2	3500	Angle Iron	9 1/2	4 3/4	3	4 1/4	6	10
240192	238470	2	3500	Pipe	9 1/2	4 3/4	3	4 1/4	6	10
240197	238470	3	3500	Angle Iron	16 3/4	6 3/4	4	4 1/4	6	10
240198	238470	3	3500	Pipe	16 3/4	6 3/4	4	4 1/4	6	10
240199	238470	4	3500	Angle Iron	22 3/4	6 3/4	4 3/4	4 1/4	6	10
240200	238470	4	3500	Pipe	22 3/4	6 3/4	4 3/4	4 1/4	6	10

\*Dimensions of bracket only.



FIGS. 29 AND 30

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Bus-strap supports for light and medium weight duty, 1½ inches to 2½ inches bus space for pipe frame mounting.

It supports the bus in place, but does not clamp it. The ampere capacity for D-C. busses is limited only by the available bus space, and for A-C. busses is limited to 10,000 amperes, maximum symmetrical short-circuit current.

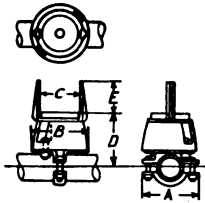


FIG. 31

Bus-Strap Support Style No.	Service Voltage	Diameter of Pipe Inches	DIMENSIONS IN INCHES					Approx. Shipping Weight Lbs.
			A	B	C	D	E	
238464	3500	¾	2¾	2½	1½	3 ⅞	1 ⅞	3
238465	3500	¾	2¾	3½	2½	3 ⅞	1 ⅞	3
238466	3500	1¼	3½	2½	1½	3 ⅞	1 ⅞	3
238467	3500	1¼	3½	3½	2½	3 ⅞	1 ⅞	3

Bus-strap supports for heavy duty, 3-inch to 6-inch bus- straps, flat mounting. It supports the bus in place, but does not clamp it. The bus space is adjustable within the limits of the given dimensions. The ampere capacity of D-C. busses is limited only by the available bus space, and for A-C. busses is limited to 25,000 amperes maximum short-circuit current, bus spacing to be not less than 10-inch centers. For heavier currents, type P supports should be ordered.

Style number includes support complete.

Bus-Strap Support Style No.	Service Voltage	DIMENSIONS IN INCHES					Approx. Shipping Weight Lbs.
		A	B	C	D	E	
238838	3500	3½	5½	0	3 ⅞	2 ⅞	6
238839	3500	3½	10¾	5½	9	2 ⅞	6

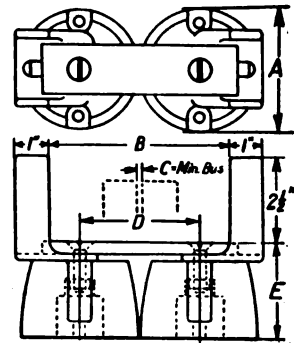


FIG. 32

Bus-strap support for heavy duty, for 3-inch to 6-inch bus- straps and 1¼-inch pipe frame mounting. It supports the bus in place, but does not clamp it. The bus space is adjustable within the limits of the given dimensions. The ampere capacity of D-C. busses is limited only by the available bus space, and for A-C. busses is limited to 25,000 amperes maximum short-circuit current, bus spacing to be not less than 10-inch centers. For heavier currents, type P supports should be ordered.

Style number includes support complete with mounting bolts.

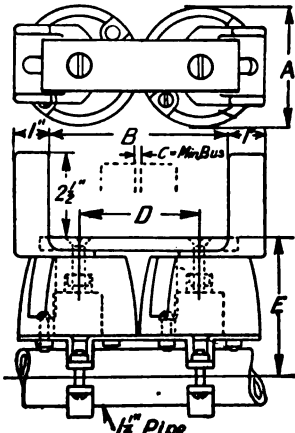


FIG. 33

Bus-Strap Support Style No.	Service Voltage	DIMENSIONS IN INCHES					Approx. Shipping Weight Lbs.
		A	B	C	D	E	
238842	3500	3½	5½	0	3 ⅞	3 ¾	8
238843	3500	3½	10¾	5½	9	3 ¾	8

Bus-rod supports for bus-rods of ½ inch to 2¼ inches diameter, flat mounting. Style number includes support complete.

Bus-Rod Support Style No.	Service Voltage	Maximum Diameter of Bus-Rod Inches	DIMENSIONS IN INCHES						Approx. Shipping Weight Lbs.
			A	B	C	D	E	F	
239401	3500	½	3	☆		2	2½	1 ⅞	3
239401	3500	¾	3	☆		2	2½	1 ⅞	3
239402	3500	1	3	☆		2	2½	1 ⅞	3
239402	3500	1¼	3	☆		2	2½	1 ⅞	3
*239405	3500	1½	3¼	☆		3 ⅞	3 ⅞	2 ⅞	3
*239405	3500	1¾	3¼	☆		3 ⅞	3 ⅞	2 ⅞	3
*239408	3500	2	3¼	☆		3 ⅞	3 ⅞	2 ⅞	3
*239408	3500	2¼	3¼	☆		3 ⅞	3 ⅞	2 ⅞	3

\*For A-C. applications where mechanical stresses due to short circuits may have to be met, space between center line of busses to be not less than 10 inches.

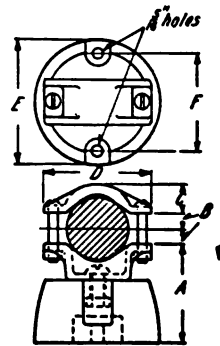


FIG. 34

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Bus-rod supports for bus-rods of 1/2 inch to 2 1/4 inches diameter. For pipe frame mounting. Style number includes support complete and mounting bolts.

Bus-Rod Support Style No.	Service Voltage	Maximum Diameter of Bus-Rod, Inches	Diam. of Pipe, Inches	DIMENSIONS IN INCHES					Approx. Shipping Weight, Lbs.
				A	B	C	D	E	
239385	3500	1/2	1/2	3 3/4	4	4	2	2 1/4	4
239385	3500	3/4	3/4	3 3/4	4	4	2	2 1/4	4
239386	3500	1	1	3 3/4	4	4	2	2 1/4	4
239386	3500	1 1/4	1 1/4	3 3/4	4	4	2	2 1/4	4
239389	3500	1 1/2	1 1/2	4	4	4	2	2 1/4	4
239389	3500	1 3/4	1 3/4	4	4	4	2	2 1/4	4
239390	3500	1	1 1/4	4	4	4	2	2 1/4	4
239390	3500	1 1/4	1 1/4	4	4	4	2	2 1/4	4
*239393	3500	1 1/2	1 1/2	3 3/4	4	4	3 1/4	3 1/4	4
*239393	3500	1 3/4	1 3/4	3 3/4	4	4	3 1/4	3 1/4	4
*239394	3500	2	2	3 3/4	4	4	3 1/4	3 1/4	4
*239394	3500	2 1/4	2 1/4	3 3/4	4	4	3 1/4	3 1/4	4
*239397	3500	1 1/2	1 1/2	4	4	4	3 1/4	3 1/4	4
*239397	3500	1 3/4	1 3/4	4	4	4	3 1/4	3 1/4	4
*239398	3500	2	1 1/4	4	4	4	3 1/4	3 1/4	4
*239398	3500	2 1/4	1 1/4	4	4	4	3 1/4	3 1/4	4

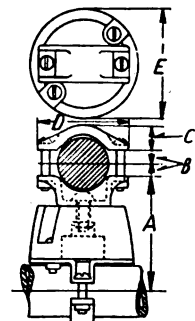


FIG. 35

\*For A-C. applications where mechanical stresses due to short circuits may have to be met, space between center line of busses to be not less than 10 inches.

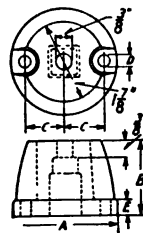


FIG. 36

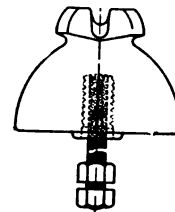


FIG. 37

Plain porcelain insulators, dry process, for bus-bar supports shown in Figs. 28 to 35.

Approximate shipping weight 1 pound.

Insulator Style No.	Maximum Service Voltage	DIMENSIONS IN INCHES				
		A	B	C	D	E
234973	3500	2 1/4	2 1/4	1 1/4	1/4	3 1/2
234974	3500	3 1/2	2 1/4	1 3/4	1/4	3 1/2

Bus-rod brackets, consisting of a line insulator and cast iron pin. This pin is designed for clamping on to a 1 1/4-inch pipe by a U-bolt, or may be bolted to a flat surface. Style number includes insulator pin and U-bolt.

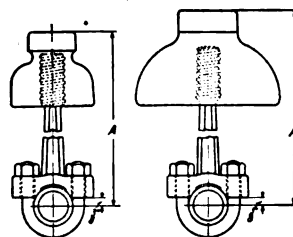


FIG. 38

Bus-rod brackets, line insulator type, for frame mounting—These bus-rod brackets, or insulated supports, consist of a line-type insulator and an iron pin. While quite a number of brackets are listed here, the essential difference outside of the voltage rating is in the shape of the pin. These shapes cover a very wide range of application, and should be sufficient to satisfy any probable condition.

The threaded rod pins are ordinarily cemented in the insulator.

The cast iron pins have a thread cast on the insulator end, and easily thread into the insulator, a tight fit being obtained by first winding oakum around the threaded part of the pin. This eliminates the consideration as to whether the insulator groove is in the correct position in regard to the location of the mounting holes of the pin as the insulators may be turned sufficiently on the pin to obtain the desired relation. The style number includes the insulator and pin assembled.

The bus-rod bracket consists of a line insulator, threaded rod pin, six inches long, and two hexagon iron nuts.

Style No.	Voltage Indoor Service	Groove, Inches	Dimension A, Inches	Style No. Insulator	Approx. Shipping Wt., Lbs.	Style No.	Voltage Indoor Service	Groove, Inches	Dimen. A, Inches	Diam. Pin, In.	Style No. Insulator	Approx. Ship. Wt., Lbs.
127806	6600	3/4	6 3/4	251670	8	164265	6600	3/4	7 1/4	1 1/4	111040	8
164295	15000	3/4	8 3/4	312988	8	164267	15000	3/4	7 1/4	1 1/4	312988	8
164296	25000	3/4	10 1/4	312989	8	164268	25000	3/4	7 3/4	1 1/4	312989	8

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Line insulators, (Fig. 39) brown glazed porcelain, threaded for standard 1-inch wooden insulator pin.

Style No.	Voltage Indoor Service	Test Voltage for one Minute	Groove, Inches	DIMENSIONS IN INCHES		
				B	C	D
251870	6600	20000	5/8	3 3/4	2 1/4	3
312988	15000	45000	3/4	6	2 3/4	3 3/4
312989	25000	66000	3/4	6 3/4	3 3/8	5

These line insulators, with a tapped sleeve cemented in the pin hole, are very serviceable for ready mounting on the projecting ends of threaded rods or bolts which have previously been fastened in the walls or other masonry during construction of the building. These sleeves have a 1/2-inch 13 tap.

Bus-rod brackets, knob insulator type, for frame mounting—These brackets are of cast iron, suitable for bolting to angle-iron frame or clamping to pipe frame, and are provided with porcelain knob insulator for supporting the bus-rods. They are designed for 2500 volts maximum indoor service, with wire or rod insulated for 2500 volts.

Style number includes bracket complete with insulators and with bracket mounting bolts.

STYLE No. 111040 DESCRIPTION Insulator includes style No. 251670 with tapped sleeve cemented in.

Knob insulators, (Fig. 40) white glazed porcelain, designed for 2500 volts maximum indoor service with 2500-volt insulated wire or rod.

Style No. 79834 Description Porcelain Insulator, 1/4 inch groove.  
79836 Porcelain Insulator, 1/2 inch groove.

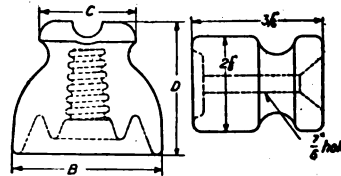


FIG. 39 FIG. 40

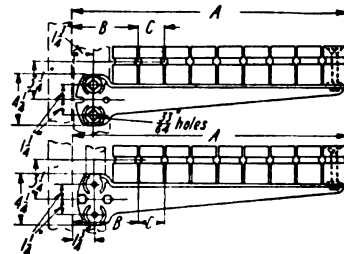


FIG. 41

FIG. 42

Bracket Style No.	Type of Frame	Figure	Number of Rods
238844	Angle Iron	41	2
238845	Angle Iron	41	2
217752	Angle Iron	41	3
217756	Angle Iron	41	3
217753	Angle Iron	41	4
217757	Angle Iron	41	4
217754	Angle Iron	41	6
217758	Angle Iron	41	6
217755	Angle Iron	41	8
217759	Angle Iron	41	8
238846	1 1/2-Inch Pipe	42	2
238847	1 1/2-Inch Pipe	42	2
217760	1 1/2-Inch Pipe	42	3
217764	1 1/2-Inch Pipe	42	3
217761	1 1/2-Inch Pipe	42	4
217765	1 1/2-Inch Pipe	42	4
217762	1 1/2-Inch Pipe	42	6
217766	1 1/2-Inch Pipe	42	6
217763	1 1/2-Inch Pipe	42	8
217767	1 1/2-Inch Pipe	42	8

Diameter of Rod Inches	DIMENSIONS IN INCHES			Approx. Shipping Weight, Lbs.
	A	B	C	
1 1/2	9 1/2	5 1/2	2 1/2	10
3/4	9 1/2	5 1/2	2 1/2	10
1 1/2	14 1/2	7 1/2	2 1/2	10
3/4	14 1/2	7 1/2	2 1/2	10
1 1/2	14 1/2	5 1/2	2 1/2	10
3/4	14 1/2	5 1/2	2 1/2	10
1 1/2	22 1/2	9 1/2	2 1/2	10
3/4	22 1/2	9 1/2	2 1/2	10
1 1/2	22 1/2	5 1/2	2 1/2	10
3/4	22 1/2	5 1/2	2 1/2	10
1 1/2	9 1/2	5 1/2	2 1/2	10
3/4	9 1/2	5 1/2	2 1/2	10
1 1/2	14 1/2	7 1/2	2 1/2	10
3/4	14 1/2	7 1/2	2 1/2	10
1 1/2	14 1/2	5 1/2	2 1/2	10
3/4	14 1/2	5 1/2	2 1/2	10
1 1/2	22 1/2	9 1/2	2 1/2	10
3/4	22 1/2	9 1/2	2 1/2	10
1 1/2	22 1/2	5 1/2	2 1/2	10
3/4	22 1/2	5 1/2	2 1/2	10

Micarta cleats used for small wiring (with rubber-covered wire) on the rear of switchboard. The cleats are so designed that the wiring may run in two or more tiers, as required.

Style number includes micarta cleat only, without anchors.

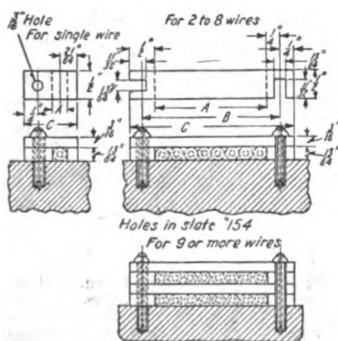


FIG. 43

Micarta Cleat Style No.	Backing Piece Style No.	No. of Wires	*No. of Screws and Anchors	DIMENSIONS IN INCHES			Approx. Ship. Wt., Lbs.
				A	B	C	
199651		1	1	1 1/2	1 1/2	1 1/2	1
199652	308381	2	2	1 1/2	1 1/2	1 1/2	1
199653	308382	3	2	1 1/2	1 1/2	1 1/2	1
199654	308383	4	2	1 1/2	1 1/2	1 1/2	1
199655	308384	5	2	1 1/2	1 1/2	1 1/2	1
199656	308385	6	2	1 1/2	1 1/2	1 1/2	1
199657	308386	7	2	1 1/2	2 1/2	2 1/2	1
199658	308387	8	2	2 1/2	2 1/2	3 1/2	1

\*For fastening cleat on panel, anchor style No. 286357 should be ordered extra for single tier, or anchor style No. 286358 for double tiers.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

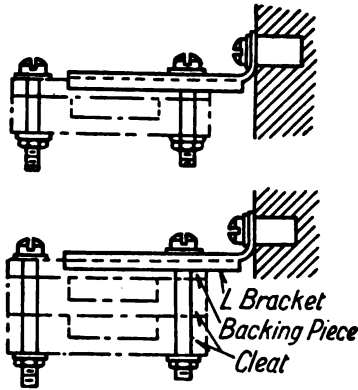


FIG. 43A

Style No.	Description
310300	Bracket for Single Tier Wiring
310301	Bracket for Double Tier Wiring

**Micarta Backing Pieces** are used in combination with the Micarta cleats when the latter are mounted on the "L" Brackets listed below, and as indicated in the cut. One is required on each bracket of a size corresponding to the cleat.

**"L" Bracket for Supporting Wiring Cleats at Right Angles to Switchboard**—The cut shows clearly the application of this bracket. It is extremely useful in confined positions where it is difficult to place the wiring flat on the panel. The cleats may be used in single or double tiers. The style numbers include screw and anchor for attaching to panel, as well as screws for attaching the cleats to the bracket. Specify cleats of the size desired with the necessary backing pieces from the list at the bottom of preceding page.

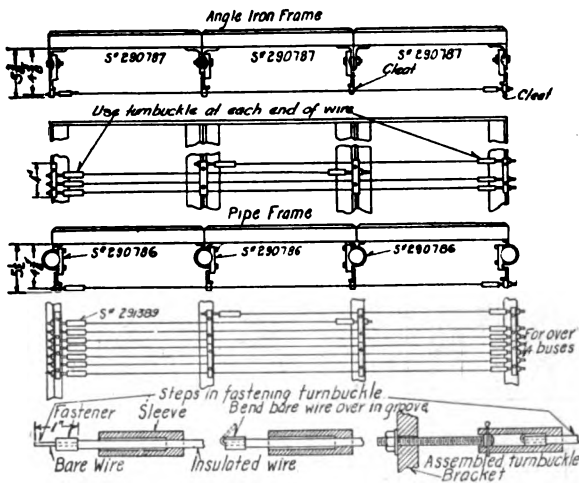


FIG. 44

**Bus Wire Brackets and Insulated Wire Stretchers**—These brackets are used for supporting small wiring busses across the switchboard panels and are made in two forms; for vertical wiring (Fig. 44) where wires are assembled in a plane parallel to the rear of the panel, and for horizontal wiring (Fig. 44-A) where wires are assembled in a plane perpendicular to the rear of the panel.

For vertical wiring the brackets will accommodate four wires in each tier. The use of these brackets in gangs in the same tier maintains uniform spacing of wires.

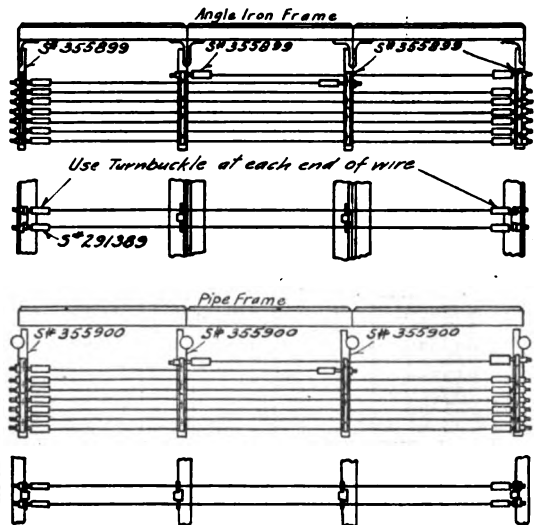


FIG. 44A

For horizontal wiring the brackets will accommodate eight wires in each tier and are recommended where conservation of vertical space on the rear of the panel is desired.

**Style number** of the bracket includes a complete bracket for one tier of wires, but does not include wire stretchers.

The wire stretchers are used for tightening the wires, each wire being separately held and stretched. Two wire stretchers are required for each bus wire. **Style number** includes one wire stretcher complete.

STYLE No.		Description	Fig. No.	Approx. Ship. Wt., Lbs.
Pipe Frame	Angle Frame			
290786	290787	Bracket for Vertical Bus	44	2
355900	355899	Bracket for Horizontal Bus	44A	2
291389	291389	Wire Stretcher	44 or 44A	1/4

**Installation Directions**—Place wires in brackets, cleats being loose and stretchers adjusted to greatest length. Fasten stretchers on the end brackets and pull wire taut by adjusting at both ends. Then clamp intermediate cleats.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

BUS-BAR CLAMPS

These clamps are made of malleable iron. For direct-current application, two single iron clamps with necessary iron bolts may be used to make a complete clamp, while for alternating-current application two single iron clamps with the necessary brass bolts may be used. Brass clamps will be supplied on special order.

Style number includes one single clamp only. Bolts should be ordered extra to suit bus thickness desired; two bolts for each two-bolt clamp connection; three bolts for each three-bolt clamp connection and four bolts for each four-bolt clamp connection. For bus space, see Figs. 7, 8, 13, 14, 15 and 17.

Two-bolt type

Malleable Iron Clamp Style No.	Width of Bus, Inches	Width of Connector, Inches	DIMENSIONS IN INCHES							Approx. Shipping Wt., Lbs.
			A	B	C	D	E	F*	G	
196303	1½	1 to 1½	2¾	2¼	3¾	1¼	¾	1¼	¾	1
196303	2	1	2¾	2¼	3¾	1¼	¾	1¼	¾	1
196305	2	1½ to 2	3	3¾	4½	1½	¾	1½	¾	1
196305	3	1	3	3¾	4½	1½	¾	1½	¾	1
196307	3	1½ to 2	3¾	4½	5½	1¾	¾	1½	¾	1
196307	4	1	3¾	4½	5½	1¾	¾	1½	¾	1
196309	3	3	4¾	5½	6¼	1¾	¾	1¾	¾	2
196309	4	1½	4¾	5½	6¼	1¾	¾	1¾	¾	2
196311	4	3	5¾	6½	7¼	1¾	¾	1¾	¾	2
196313	4	4	6½	7¼	8¼	2	¾	1¾	¾	2
196313	6	1 to 2	6½	7¼	8¼	2	¾	1¾	¾	2



FIG. 45

Three-bolt type

Malleable Iron Clamp Style No.	Width of Bus, Inches	Width of Connector, Inches	DIMENSIONS IN INCHES							Approx. Shipping Wt., Lbs.
			A	B	C	D	E	F*	G	
253584	3	5 to 6	5½	6½	3½	7½	4½	1¾	¾	3
253585	4	5 to 6	5½	6½	4½	7½	5½	1¾	¾	3
253586	3	4 to 4½	4¾	5	3½	6½	4½	1¾	¾	3
253587	4	4 to 4½	4¾	5	4½	6½	5½	1¾	¾	3
253588	5	5 to 6	5½	6½	5½	7½	6½	2	¾	4
253589	6	5 to 6	5½	6½	6½	7½	7½	2	¾	4
253590	5	4 to 4½	4¾	5	5½	6½	6½	2	¾	4
253591	6	4 to 4½	4¾	5	6½	6½	7½	2	¾	4

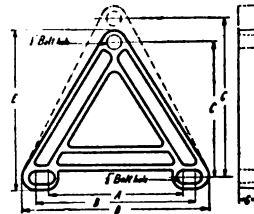


FIG. 46

Four-bolt type

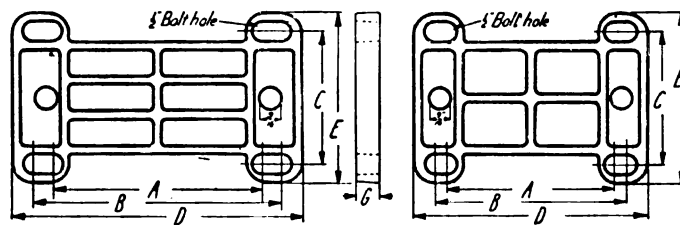


FIG. 47

Malleable Iron Clamp Style No.	Width of Bus, Inches	Width of Connector, Inches	DIMENSIONS IN INCHES							Approx. Shipping Wt., Lbs.
			A	B	C	D	E	F*	G	
238628	3	5 to 6	5½	6½	3½	7½	4½	2	¾	5
238629	4	5 to 6	5½	6½	4½	7½	5½	1¾	¾	5
238630	5	5 to 6	5½	6½	5½	7½	6½	2	1	5
238631	6	5 to 6	5½	6½	6½	7½	7½	2	1	5
238632	3	4 to 4½	4¾	5	3½	6½	4½	1¾	¾	4
238633	4	4 to 4½	4¾	5	4½	6½	5½	1¾	¾	4
238634	5	4 to 4½	4¾	5	5½	6½	6½	2	¾	4
238635	6	4 to 4½	4¾	5	6½	6½	7½	2	¾	4

\*Total length of clamping bolt required equals dimension F in table, plus thickness of bus, all bolts ¾-inch diameter.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Iron machine bolts**—The following iron machine bolts are used with bus-bar clamps and clamp terminals. Iron machine bolts should be used for direct-current service, and for alternating-current service only with a clamp terminal; in all other cases a brass machine screw or bolt should be used.

Size of Bolt, Inches	Size of Bolt, Inches	Size of Bolt, Inches
1/4x1 1/2	3/8x1 3/4	1/2x2
1/4x1 3/4	3/8x2	1/2x2 1/4
1/4x2	3/8x2 1/4	1/2x2 1/2
1/4x2 1/2	3/8x2 1/2	1/2x3
1/4x3	3/8x3	1/2x4
1/4x3 1/2	3/8x3 1/2	1/2x4 1/2
	3/8x4	

Brass Machine Screw Size—Inches	Brass Machine Screw Size—Inches
.242-24x1 1/4	.372-16x1 1/2
.242-24x1 1/2	.372-16x1 3/4
.242-24x1 3/4	.372-16x2 1/4
.242-24x2 1/4	.372-16x2 3/4
.242-24x2 3/4	.372-16x3 1/2
.242-24x3	.372-16x4
.242-24x3 1/2	

Brass Machine Bolts		
Size—In.	Style No. Bolt with Iron Nut	Approx. Shipping Wt., Lbs.
1/2x2	253362	1
1/2x2 1/2	253363	1
1/2x3	253364	1
1/2x2 1/2	253365	1
1/2x4	253366	1
1/2x4 1/2	253367	1

**Brass machine screws and bolts**—The following fillister head brass machine screws and brass machine bolts with iron nuts are used with bus-bar clamps for alternating-current service.

Note—1/2-inch bolts are required only with the two-bolt clamp, style numbers 196309 to 196314, inclusive, and with the two-bolt clamp terminals, style numbers 196399 to 196403, inclusive, and 196319 to 196323, inclusive.

BUS-BAR TERMINALS

**Bus-bar terminals** for lead parallel to side of bus-bar. Length of bolt required equals thickness of bus, plus dimension D in table.

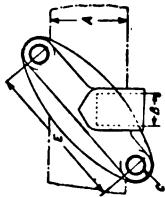


FIG. 48

One bus-bar clamp, Fig. 45, and one terminal, Fig. 48, compose one complete bus-bar clamp.

**Bus-bar terminals** for clamp connection to flat bus-bar. These terminals are made of cast brass or cast copper and are designed primarily for making a clamp connection to flat bus-bar. Iron clamps for the opposite side of the bus when required, bus spacers when required, and bolts should be ordered extra.

One bus-bar terminal, Fig. 49, and one clamp, Fig. 45, compose one complete bus-bar clamp.

Length of bolt required equals thickness of bus, plus dimension D in table.

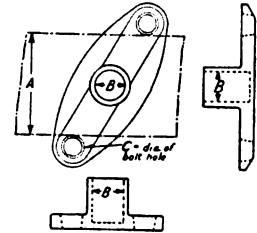


FIG. 49

FIG. 48 TERMINAL Style No.	FIG. 45 CLAMP Style No.	DIMENSIONS IN INCHES					Approx. Ship. Wt., Lbs.
		A	B	C	D	E	
240201	196303	2	1/2	1/8	1 1/8	2 1/4	3
240202	196303	2	5/8	1/8	1 1/8	2 1/4	3
240203	196303	2	3/4	1/8	1 1/8	2 1/4	3
196394	196305	2	1 1/4	3/8	1 1/2	3 3/4	3
196395	196305	2	1 1/4	3/8	1 1/2	3 3/4	3
240204	196305	3	1 1/2	3/8	1 1/2	3 3/4	3
240205	196305	3	1 1/2	3/8	1 1/2	3 3/4	3
240206	196305	3	1 1/2	3/8	1 1/2	3 3/4	3
196397	196305	3	1 1/2	3/8	1 1/2	3 3/4	3
196398	196305	3	1 1/2	3/8	1 1/2	3 3/4	3
196399	196309	3	1 1/2	3/8	1 1/2	5 1/4	3
196400	196313	5	1 1/2	3/8	1 3/4	7 1/8	5
196400	196313	6	1 1/2	3/8	1 3/4	7 1/8	5
196401	196313	5	1 1/2	3/8	1 3/4	7 1/8	5
196401	196313	6	1 1/2	3/8	1 3/4	7 1/8	5
196402	196313	5	1 1/2	3/8	1 3/4	7 1/8	5
196402	196313	6	1 1/2	3/8	1 3/4	7 1/8	5
196403	196313	5	1 1/2	3/8	1 3/4	7 1/8	5
196403	196313	6	1 1/2	3/8	1 3/4	7 1/8	5

Dimension A is maximum width of bus space.  
\*Maximum diameter of hole for cable, to be drilled as required.

FIG. 49 TERMINAL Style No.	FIG. 45 CLAMP Style No.	DIMENSIONS IN INCHES				Approx. Shipping Wt., Lbs.
		A	B	C	D	
196315	196303	2	1 1/4	1/8	1 1/4	3
196316	196305	3	1 1/2	3/8	1 1/2	3
196317	196305	2	1 1/2	3/8	1 1/2	3
196317	196305	3	1 1/2	3/8	1 1/2	3
196318	196305	2	1 1/2	3/8	1 1/2	3
196318	196305	3	1 1/2	3/8	1 1/2	3
196319	196309	3	1 1/2	3/8	1 1/2	3
196320	196311	5	1 1/2	3/8	1 3/4	5
196320	196313	6	1 1/2	3/8	1 3/4	5
196321	196311	5	1 1/2	3/8	1 3/4	5
196321	196313	6	1 1/2	3/8	1 3/4	5
196322	196311	5	1 1/2	3/8	1 3/4	5
196322	196313	6	1 1/2	3/8	1 3/4	5
196323	196311	5	1 1/2	3/8	1 3/4	5
196323	196313	6	1 1/2	3/8	1 3/4	5

Dimension A is maximum width of bus space.  
\*Maximum diameter of hole for cable, to be drilled as required.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

TEE CONNECTORS

**Tee connectors** for clamped main connection and soldered branch connections.  
**Style number** includes connector with clamp and stove bolts.

Connector Style No.	Fig. No.	Diam. of Main Hole, Inches	Diam. of Branch Hole, Inches	DRILLED FOR CONNECTORS		DIMENSIONS IN INCHES				Approx. Shipping Wt., Lbs.
				Main, Inches	Branch, Inches	A	B	C	D	
240208	50	1 1/4	3/8	.258	.258	1	1 3/8	1 1/2	1 1/4	2
240207	50	3/4	3/8	.365	.365	1	1 3/8	1 1/2	1 1/4	2
240210	50	1/2	3/8	.460	.258	1 1/4	1 1/4	1 1/2	1 1/4	2
240209	50	1/2	3/8	.460	.365	1 1/4	1 1/4	1 1/2	1 1/4	2
8889	50	1/2	3/8	.460	.460	1 1/4	1 1/4	1 1/2	1 1/4	2
164988	50	1/2	3/8	...	...	2 1/4	2 1/4	1 1/2	1 1/4	2
74508	50	3/4	3/8	...	...	1 1/4	1 1/4	1 1/2	1 1/4	2
74509	51	3/4	3/8	...	...	3	1 1/4	1 1/2	1 1/4	2
164989	50	3/4	3/8	...	...	3	2 1/4	1 1/2	1 1/4	2
198202	50	3/4	3/8	...	...	3	3 3/8	1 1/2	1 1/4	2
198203	50	1	3/8	1	...	1 1/2	1 1/4	1 1/2	1 1/4	3
198204	51	1	3/8	1	...	3	1 1/4	1 1/2	1 1/4	3
198205	50	1	3/8	1	...	3	2 1/4	1 1/2	1 1/4	3
198206	50	1	3/8	1	...	3	2 1/4	1 1/2	1 1/4	3

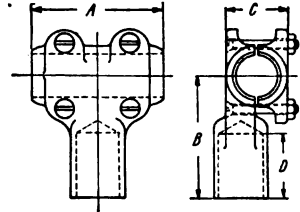


FIG. 50

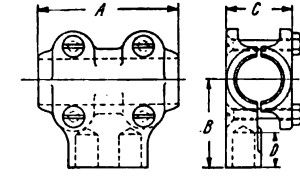


FIG. 51

\*Style No. includes Tee Connectors, undrilled. Dimensions given are the maximum diameter of hole for which connector may be drilled. Specify drilling when ordering.

TERMINAL CONTACT NUTS

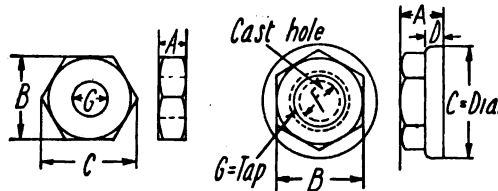


FIG. 56

FIG. 57

Nut Style No.	For Studs Diameter in Inches	Fig. No.	DIMENSIONS IN INCHES					G
			A	B	C	D	F	
48888	1/4	56	3/8	3/8	1	...	...	.242-24
15309	3/8	56	1/4	1/2	1 1/4	...	...	7-18
7299	3/8	56	3/8	5/8	1 1/4	...	...	3/4-16
7543	1/2	56	1/2	1	1 3/4	...	...	1/2-13
233307	5/8	57	1/2	3/4	1 3/4	...	...	3/4-11
232428	3/4	57	5/8	1	1 3/4	...	...	3/4-16
230888	1	57	3/4	1 3/8	1 7/8	...	...	1-14
230889	1 1/4	57	3/4	1 3/8	2 1/8	...	1	1 1/4-14
230890	1 1/2	57	7/8	1 1/2	2 1/2	...	1 1/4	1 1/2-14
230891	1 3/4	57	1	1 3/4	3	...	1 3/8	1 3/4-12
101140	2	57	1	2 1/4	3 1/4	...	...	2 -12

Order by Style Number



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Strap Terminal Spacers are used in connection with the flanged nuts listed above where a number of strap laminations are brought onto a single stud. They are made of brass with the contact surfaces machined. Sizes suitable for studs of from 1 inch to 2½ inches in diameter and either ¼ or ⅝ inch thick can be obtained.

Style No.	DIMENSIONS IN INCHES		
	A	B	C
232242	1 1/4	2 1/2	1/4
232243	1 1/2	3	1/4
232411	1 1/2	1 1/2	1/4
288992	1 1/2	1 1/2	1/4
288993	1 1/2	2	1/4
288994	1 1/2	2 1/2	1/4
288995	1 1/2	2 1/2	1/4
288996	1 1/2	3	1/4
288997	2 1/2	3 1/4	1/4
288998	2 1/2	3 1/4	1/4
288999	2 1/2	4 1/4	1/4
289000	2 1/2	4 1/4	1/4
289001	2 1/2	4 1/4	1/4
289002	2 1/2	4 1/4	1/4

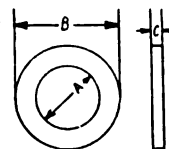


FIG. 58

COPPER TERMINALS

The terminals listed in the following tables are made from drawn copper. Straight terminals up to and including .559 inches inside diameter are seamless all around and are superior in appearance to any others. All the other terminals are made from seamless copper tubing. The best conductivity is secured in both types.

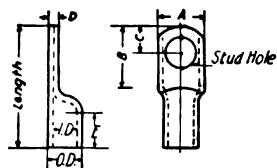


FIG. 59

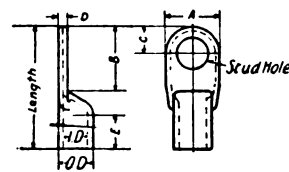


FIG. 60

Style No.	Ampere Capacity Rubber Insulated Conductors	Maximum stranded wire or cable size	DIMENSIONS IN INCHES									
			I. D.	O. D.	Diam of Stud Hole	Length	A	B	C	D	E	
<b>Straight Terminals—One Bolt Hole—Figs. 59 and 60</b>												
229105	35	8	.186	.25	1/4	1 1/4	3/8	1 1/2	1/4	1/4	1/4	1/4
243961	70	4	.259	.344	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229111	70	4	.259	.344	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229112	70	4	.259	.344	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229114	125	0	.384	.469	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
243962	125	0	.384	.469	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229113	125	0	.384	.469	1/2	1 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
269917	225	0000	.558	.688	1/2	2 1/2	1	1 1/2	1/4	1/4	1/4	1/4
229119	225	0000	.558	.688	1/2	2 1/2	1	1 1/2	1/4	1/4	1/4	1/4
229120	225	0000	.558	.688	1/2	2 1/2	1	1 1/2	1/4	1/4	1/4	1/4
243968	275	300000	.745	.875	1/2	3	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229127	400	500000	.918	1.063	1/2	3 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229128	400	500000	.918	1.063	1/2	3 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
243993	550	800000	1.12	1.313	1/2	4 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229133	650	1000000	1.28	1.5	1/2	4 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
229134	650	1000000	1.28	1.5	1/2	4 1/2	1 1/2	1 1/2	1/4	1/4	1/4	1/4
292234	1000	1500000	1.5	1.813	1/2	5 1/2	2 1/4	2 1/4	1	1/4	1/4	1/4
235904	1000	1500000	1.5	1.813	1 1/4	5 1/2	2 1/4	2 1/4	1	1/4	1/4	1/4
233458	1000	1500000	1.5	1.813	1 1/4	5 1/2	2 1/4	2 1/4	1	1/4	1/4	1/4
233459	1200	2000000	1.75	2.063	1 1/4	6 1/2	3 1/4	3 1/4	1 1/4	1/4	1/4	1/4
229773	1200	2000000	1.75	2.063	1 1/4	6 1/2	3 1/4	3 1/4	1 1/4	1/4	1/4	1/4

Frankel solderless connectors can be supplied for terminals. For prices and information refer to Section 41-C, "Knife Switches and Miscellaneous Wiring Devices."

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

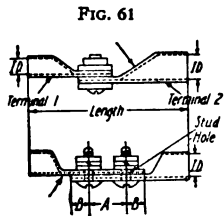


FIG. 62

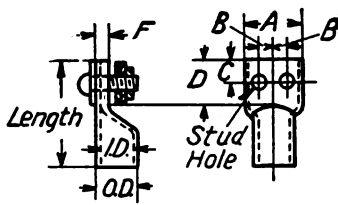


FIG. 63

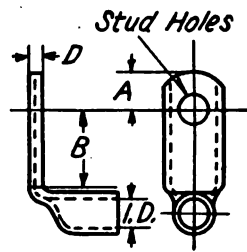


FIG. 64

Straight Terminals—One Vertical Bolt Hole—Fig. 61

Style No.	AMPERE CAPACITY RUBBER INSULATED CONDUCTORS		MAXIMUM STRANDED WIRE OR CABLE SIZE		DIMENSIONS IN INCHES		
	Term 1	Term 2	Term 1	Term 2	Term 1	Term 2	Length
292251	35	35	8	8	.186	.186	1 3/4
292252	35	70	8	4	.186	.259	1 3/8
301781	35	125	8	0	.186	.384	2 1/8
301782	70	70	4	4	.259	.259	2 1/8
292253	70	125	4	0	.259	.384	2 1/8
301783	70	225	4	0000	.259	.558	3
301784	125	125	0	0	.384	.384	2 3/4
292254	125	225	0	0000	.384	.558	3 1/4
301785	125	275	0	300,000	.384	.745	3 1/2
301786	225	225	0000	0000	.558	.558	3 1/2
292255	225	275	0000	300,000	.558	.745	4 1/8
301787	225	400	0000	500,000	.558	.918	4 1/2
301788	275	275	300,000	300,000	.745	.745	4 1/2
292256	275	400	300,000	500,000	.745	.918	5 1/8
301789	275	550	300,000	800,000	.745	1.12	5 1/2
301770	400	400	500,000	500,000	.918	.918	5 1/2
292257	400	550	500,000	800,000	.918	1.12	6 1/4
301771	400	650	500,000	1,000,000	.918	1.28	6 1/4
301772	550	550	800,000	800,000	1.12	1.12	6 3/4
292258	550	650	800,000	1,000,000	1.12	1.28	7 1/4
301773	550	1000	800,000	1,500,000	1.12	1.5	7 1/2
301774	650	650	1,000,000	1,000,000	1.28	1.28	7 1/2
292259	650	1000	1,000,000	1,500,000	1.28	1.5	8 1/8
301775	650	1200	1,000,000	2,000,000	1.28	1.75	9 1/8
301776	1000	1000	1,500,000	1,500,000	1.5	1.5	9 1/2
302430	1000	1200	1,500,000	2,000,000	1.5	1.75	9 3/8

Style No.	Ampere Capacity Rubber Insulated Conductors	Maximum Stranded Wire or Cable Size	DIMENSIONS IN INCHES					
			I. D.	O. D.	Diam. of Stud Hole	Length	A	B

Straight Terminals—Two Vertical Bolt Holes—Fig. 62

270528	80	3	.259	.....	3/8	2 1/8	1 1/8	1/4	.....	.....	.....
270529	125	0	.384	.....	3/8	3 1/8	1 5/8	1/4	.....	.....	.....
270532	225	0000	.559	.....	3/8	4 1/4	3 3/8	3/8	.....	.....	.....
270533	275	300,000	.745	.....	3/8	4 1/4	7 3/8	1/2	.....	.....	.....
272214	400	500,000	.918	.....	1 1/2	6	1	1 1/2	.....	.....	.....

Straight Terminals—Two Horizontal Bolt Holes—Fig. 63

259431	650	1,000,000	1.28	1.5	1 1/8	4 3/8	2 1/4	1/2	3/4	1 1/2	.....
282087	1000	1,500,000	1.5	1.813	1 1/8	5 1/8	2 1/2	5/8	1 1/8	1 3/4	.....
282089	1200	2,000,000	1.75	2.063	1 1/8	5 1/2	3 1/8	3/4	1	2	.....

90-Degree Angle Terminals—One Bolt Hole—Fig. 64

281786	80	3	.259	.....	3/8	.....	3/8	1/4	.....	.084	.....
244130	80	3	.259	.....	3/8	.....	3/8	3/8	.....	.084	.....
292250	80	3	.259	.....	3/8	.....	3/8	3/8	.....	.084	.....
279970	80	3	.259	.....	3/8	.....	3/8	1/4	.....	.084	.....
244133	125	0	.384	.....	3/8	.....	3/8	3/8	.....	.084	.....
244134	125	0	.384	.....	3/8	.....	3/8	3/8	.....	.084	.....
179758	125	0	.384	.....	3/8	.....	3/8	3/8	.....	.084	.....
269923	225	0000	.559	.....	3/8	.....	3/8	3/8	.....	.13	.....
244144	225	0000	.559	.....	3/8	.....	3/8	3/8	.....	.13	.....

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

The straight terminals with two horizontal bolt holes shown in Fig. 63 and listed above are designed for general application where the one-bolt-hole terminals as listed are not suitable—for example, where large cable connections are made to studs of large diameters, to laminated studs, to flat terminal plates, etc. By providing a properly formed adapter, made from flat copper strap, between the

listed terminal and the stud or plate to which connection is desired, means are provided for securing varied terminal arrangements.

For general guidance, several common arrangements shown in Fig. 65 are available on special order. The style number of the terminal includes the lug without the adapting strap.

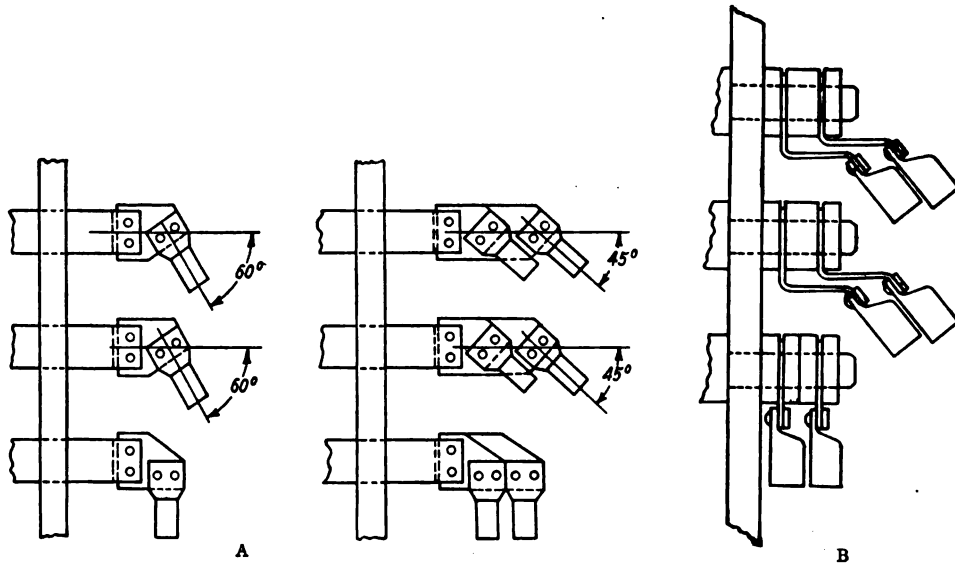


FIG. 65

UNIVERSAL MOUNTING BRACKETS

**Universal auxiliary brackets**—This cast iron bracket is designed particularly to be bolted to the universal mounting brackets or straps, thus providing a suitable mounting for current and voltage transformers, etc., in various locations.

Note — For type A current transformers use bracket Style No. 59570, Fig. 67.

**Style number** includes bracket and 3/8-inch diameter stove bolt.

designed particularly to be bolted to the end lug of the universal bracket and to provide a support for fuse and disconnecting switch bases. For individually mounted bases, two universal brackets and two end brackets are required per base, but where the bases are mounted adjacent to each other, in the same line and plane, an intermediate support for the two may be formed by using one universal bracket and one intermediate bracket. **Style number** includes bracket with mounting bolt.

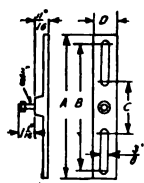


FIG. 66

Style No.	DIMENSIONS IN INCHES				Approx. Shipping Weight, Lbs.
	A	B	C	D	
72752	7	6	3 1/8	1 1/2	1
177512	9	8	3 1/8	1 1/2	1

**Mounting brackets for fuse and disconnecting switch base mounting**—This cast iron bracket is

Style No. 59570  
59571

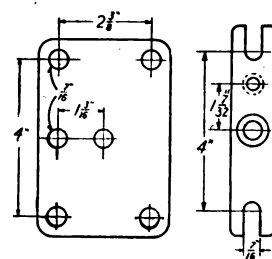


FIG. 67

End Bracket  
Intermediate Bracket

Approximate Shipping Weight, Lbs.  
1 1/2  
1 1/2

Order by Style Number

2-385A

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

UNIVERSAL MOUNTING BRACKETS AND STRAPS

The group of mounting brackets, listed below, consist of a number of cast iron slotted brackets, provided with an end lug and arranged to project at right angles to the frame uprights; a number of cast iron slotted straps, which extend across the panel, bolted to the end lug of the bracket; and a number of auxiliary brackets which bolt on the bracket or strap, as the case may be. This arrangement provides an almost unlimited number of different mountings for current and voltage transformers, fuse bases, disconnecting switches, insulator pins, knob insulators, etc.

**Universal mounting brackets**—For pipe or angle iron frame. Brackets are cast with slots in side, are provided with an end lug and are designed to project at right angles to the frame upright. The brackets are suitable for mounting on either 1¼-inch pipe frame or angle iron frame; suitable adjusting eccentric washers are provided for holding the brackets rigidly, to prevent sagging, ordinarily due to bolt hole clearances.

**Style number** includes bracket complete with straight mounting bolts for angle iron frames or with U-bolts for pipe frame mounting.

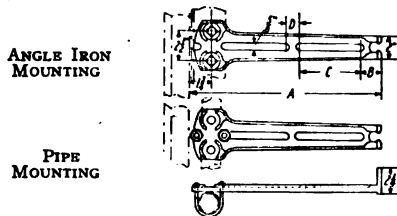


FIG. 69

Mounting Bracket Style No.	Description of Frame	No. of Slots	DIMENSIONS, INCHES				Approx. Shipping Wt., Lbs.
			A	B	C	D	
216750	Angle Iron	0	4	0	0	...	4
216751	Angle Iron	1	6	1 3/4	1 1/4	...	4
216752	Angle Iron	1	8	1 3/4	3 1/4	...	4
216753	Angle Iron	1	10	1 3/4	5 1/4	...	4
216754	Angle Iron	2	12	1 3/4	3 3/8	1 1/8	5
216755	Angle Iron	2	14	1 3/4	4 1/8	1 1/8	5
216756	Angle Iron	2	16	1 3/4	5 1/8	1 1/8	5
216757	Angle Iron	3	18	1 3/4	3 1/4	1 1/8	5
216758	Angle Iron	3	20	1 3/4	4 3/8	1 1/8	6
216759	Angle Iron	3	22	1 3/4	5 1/4	1 1/8	6
216760	Angle Iron	4	24	1 3/4	4	1 1/8	6
216761	Angle Iron	4	26	1 3/4	4 1/2	1 1/8	6
216762	1¼-Inch Pipe	0	4	0	0	...	4
216763	1¼-Inch Pipe	1	6	1 3/4	1 1/4	...	4
216764	1¼-Inch Pipe	1	8	1 3/4	3 1/4	...	4
216765	1¼-Inch Pipe	1	10	1 3/4	5 1/4	...	4

Mounting Bracket Style No.	Description of Frame	No. of Slots	DIMENSIONS, INCHES				Approx. Shipping Wt., Lbs.
			A	B	C	D	
216766	1¼-Inch Pipe	2	12	1 3/4	3 1/8	1 1/8	5
216767	1¼-Inch Pipe	2	14	1 3/4	4 1/8	1 1/8	5
216768	1¼-Inch Pipe	2	16	1 3/4	5 1/8	1 1/8	5
216769	1¼-Inch Pipe	3	18	1 3/4	3 1/4	1 1/8	5
216770	1¼-Inch Pipe	3	20	1 3/4	4 3/8	1 1/8	6
216771	1¼-Inch Pipe	3	22	1 3/4	5 1/4	1 1/8	6
216772	1¼-Inch Pipe	4	24	1 3/4	4	1 1/8	6
216773	1¼-Inch Pipe	4	26	1 3/4	4 1/2	1 1/8	6

**Universal mounting straps**, made of cast iron with 1/8 inch slots in the side, are designed particularly to be bolted on the end lugs of the universal mounting brackets, thus forming a mounting or supporting medium across the switchboard panels.

**Style number** includes bracket with mounting bolts.

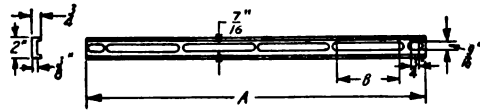


FIG. 68

Universal Strap Style No.	Width of Panel Inches	No. of Slots	DIMENSIONS IN INCHES		Approx. Ship. Wt., Lbs.
			A	B	
109008	16	2	15 1/4	5 3/8	4
109009	20	2	19 1/4	7 3/8	4
109010	22	2	21 1/4	6 3/8	4
72749	24	3	23 1/4	6	6
72750	32	4	31 1/4	6 1/4	6
72751	40	4	39 1/4	8 1/4	6

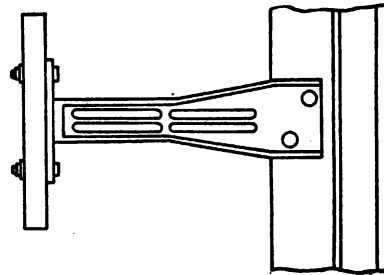


FIG. 70

**Mounting bracket for light bases** used generally for supporting terminals, and testing bases on rear of switchboard for angle iron frame mounting. It is not necessary to remove the bracket from frame when shipping.

Style No.	Approx. Shipping Wt., Lbs.
291189	3

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Mounting brackets for mounting oil circuit breakers, made of cast iron and designed to hold the supporting pipes or pipe stringers, when breakers are supported on switchboard frame instead of switchboard panel. Note that breakers with horizontal pull mechanism are ordinarily required.

Style number includes bracket and mounting bolt.

Bracket Style No.	Description	Approximate Shipping Weight, Lbs.
*216738	Mounting bracket with U-bolt for pipe frame	6
216737	Mounting bracket with mounting bolts for angle iron	6

\*Bracket and breaker cover plate should be located so as not to interfere with panel frame brackets.

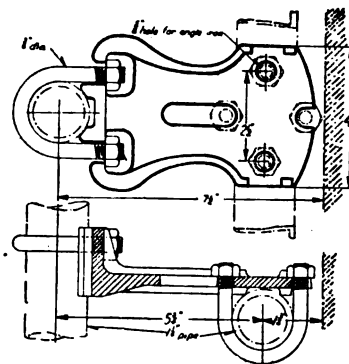


FIG. 71

Mounting brackets, Fig. 72, for types PS and FB current transformers, are made of cast iron and are designed for supporting the transformers from flat surface, as in Fig. 73.

Style number includes one bracket only.

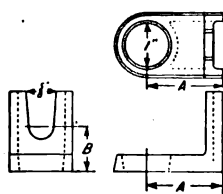


FIG. 72

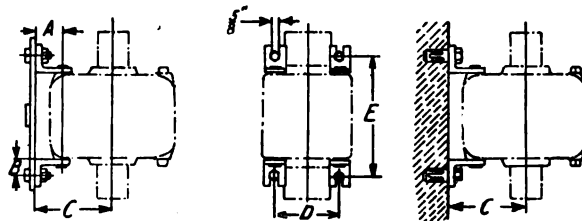


FIG. 73

Fig. 72 Mounting Bracket Style No.	APPLICATION Mounting	For Mounting Transformers Style No.	DIMENSIONS IN INCHES				
			A	B	C	D	E
*217611	Pipe	125053 to 125056	1 1/4	1	4	3 1/2	7 1/8
+217611	Flat	125057 to 125059	1 1/4	1	5 1/8	4	7 5/8
*217611	Pipe	125060 to 125062	1 1/4	1	5 1/4	4 1/8	8
+217611	Flat	125063 to 125066	1 1/4	1	3 3/4	4 3/8	7 3/8
*217611	Pipe	125067 to 125069	1 1/4	1	5	4 1/4	7 5/8
+217611	Flat	125070 to 125072	1 1/4	1	5 3/8	5 3/8	7 3/8

Approximate shipping weight 1 pound.

\*For 1 1/4-inch pipe mounting, order in addition two Style No. 127776 brackets, and four 3/8-inch by 1 1/4-inch machine bolts for each transformer.

†For flat mounting on auxiliary bracket as shown on the left of Fig. 73, order in addition, two style No. 177512 brackets, and four 3/8-inch by 1 1/4-inch machine bolts for each transformer.

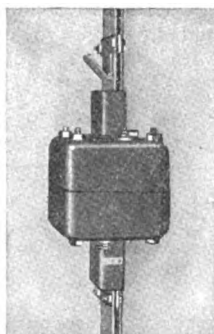


FIG. 73A

Mounting bracket, Style No. 219516 shown in Fig. 73A is used for supporting type FB current transformers on vertical risers. Two brackets are required for each transformer.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Pipe mounting brackets**—These brackets are made of cast iron for clamping on 1¼-inch pipe frame by means of U-bolts; for supporting instrument transformers, fuse blocks disconnecting switches, etc.

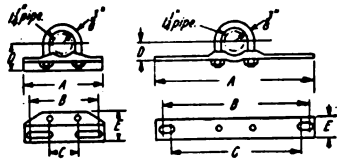


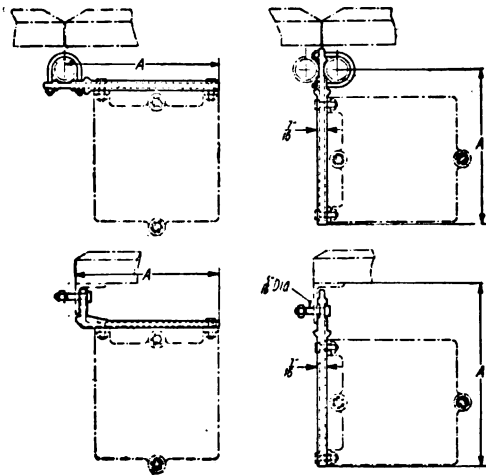
FIG. 74 FIG. 75

Bracket Style No.	Figure	DIMENSIONS IN INCHES					
		A	B	C	D	E	F
127768	74	5 5/8	4 7/8	2	1 3/4	2	1 1/4
239023	75	9 1/4	8	5	1 3/4	1 1/4	1 1/4
127776	75	9	8	2 1/2	1 1/4	1 1/4	...
239024	75	11	10	9	1 1/4	1 1/2	...

Approximate shipping weight, 2 pounds.

**Mounting bracket, light duty type**, made of cast iron and designed for supporting Westinghouse condenser sections for voltage regulator and for meter resistance, etc.

**Style number** includes bracket only, which is shown in full lines.



FIGS. 78 AND 79

Mounting Bracket Style No.	Type of Mounting Frame	Figure	Dimension
			A, Inches
228886	Angle Iron	78	11 3/4
228887	Pipe, 1 1/4 inch	79	10
228888	Angle Iron	78	9 3/4

Approximate shipping weight, 3 pounds.

**I-beam clamp for fastening transverse I-beams**—This cast iron fitting securely clamps a transverse I-beam to another I-beam, without the necessity of cutting or drilling either beam.

It is used extensively to hold the supporting I-beam to remote hand control oil circuit-breaker bell cranks.

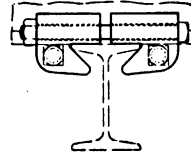


FIG. 76

Style No. 162516 Clamp without bolts, Fig. 76. Approximate shipping weight, 5 pounds.

In addition to the above, there should be ordered two 1/2-inch machine bolts, 3 1/4 inches longer than the width of one I-beam flange, and two 1/2-inch machine bolts, 3 1/4 inches longer than the width of the other I-beam flange.

**Hanger clamp**—This cast iron clamp is designed for any size I-beam without the necessity of cutting or drilling the beam. It is of service in hanging various brackets and supports from the ceiling and offers a substantial base for oil switch or circuit-breaker bell crank bearings.

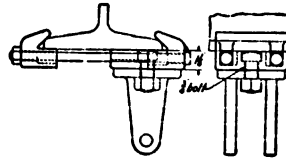


FIG. 77

Style No. 162519 Clamp without bolts, Fig. 77. Approximate shipping weight, 6 pounds.

In addition to the above, there should be ordered two 1/2-inch machine bolts, 3 1/4 inches longer than the width of the I-beam flange.

**I-beam hanger clamp, light duty type**—This iron clamp is designed for the same general purpose as the heavy duty type clamp, but for use as a support for lighter apparatus.

**Style number** includes clamps and one 3/8 inch x 1 1/4 inch machine bolt.

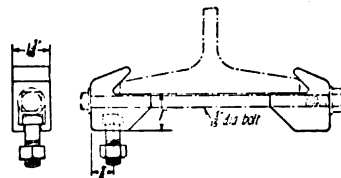


FIG. 80

Style No. \*223406 Hanger clamp with one machine bolt. Approximate Shipping weight, 3 pounds.

\*In addition there should be ordered two 1/4 inch washers and two 1/4 inch diameter machine bolts, 2 3/4 inches longer than the width of the I-beam flange.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Pipe brackets made of cast iron and designed to bolt to an angle frame and to support a 1 1/4-inch pipe at right angles to the frame upright. The bracket is tapped with straight thread of standard size to provide adjustment of the pipe to the horizontal position.

Style number includes bracket complete with mounting bolts and pipe lock nut, but does not include the pipe.

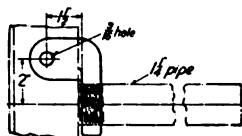


FIG. 82

Style No. 162515 Bracket complete.

Approximate shipping weight, 2 pounds.

Pipe saddle clamps made of malleable iron, and are tapped to receive pipe with standard pipe thread for branch connections, while the main connection is of the U-clamp type.

Style number includes clamp with U-bolt.

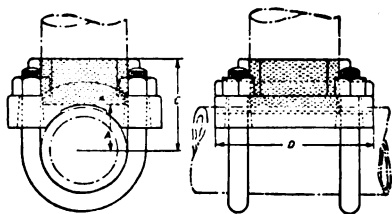


FIG. 85

Clamp Style No.	SIZE OF PIPE		DIMENSIONS IN INCHES		
	Main, Inches	Branch, Inches	A	C	D
226325	3/4	3/4	1 1/4	1 1/4	2 3/4
226324	1 1/4	3/4	1 1/4	1 1/4	2 3/4
226323	1 1/4	1 1/4	1 1/4	1 1/4	3 3/4
216390*	2	1 1/4	1 1/4	2 1/4	3 3/4
216389*	2	2	1 1/4	2 3/4	4 1/4

\*Made of cast iron.

Approximate shipping weight, 2 pounds.

Pipe mounting brackets—These brackets are made of cast iron for clamping on 1 1/4-inch pipe frames. They are designed for supporting, from

two parallel pipes, various kinds of apparatus having one mounting bolt or for clamping two parallel pipes together 4 inches between centers of pipes.

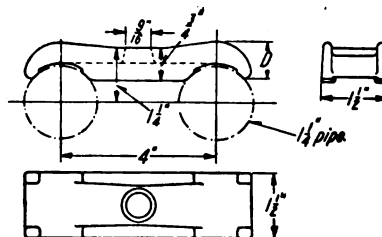


FIG. 81

Style No. 227599 Pipe mounting bracket only. Approximate shipping weight, 1 pound.

Clamps for fastening pipe to I-beam—This is a cast iron fitting that securely clamps transverse pipe to an I-beam, as shown in Figs. 83 and 84, without the necessity of cutting or drilling either the pipe or beam.

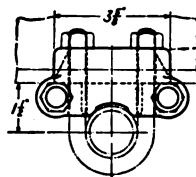


FIG. 83

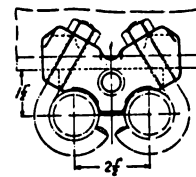


FIG. 84

Style No. 162513 Clamp for one 1 1/4-inch pipe. 162514 Clamp for two 1 1/4-inch pipes. Approximate shipping weight, 2 pounds.

The above style numbers do not include bolts, as the bolt length will vary according to size of I-beam.

In addition to above style number there should be ordered for single-pipe clamp two 1/2-inch machine bolts, 3 1/4 inches longer than width of I-beam flange; for two-pipe clamp, one 1/2-inch machine bolt, 3 1/4 inches longer than width of I-beam flange.

Pipe end clamp—This is a cast iron fitting which securely clamps a 1 1/4-inch pipe to an I-beam without the necessity of cutting the I-beam.

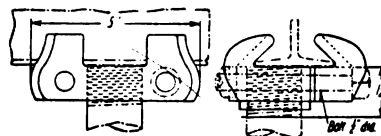


FIG. 86

Style No. 240131 Pipe end clamp. Approximate shipping weight, 2 pounds.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Wall or floor brace complete with angular adjustment, heavy duty type. This brace consists of a wall or floor clamp of the threaded type, a brace pipe clamp of the threaded type and one piece of one-inch wrought iron pipe, 4 feet, 2 inches long, threaded at both ends.

Style number includes brace complete with necessary bolts.

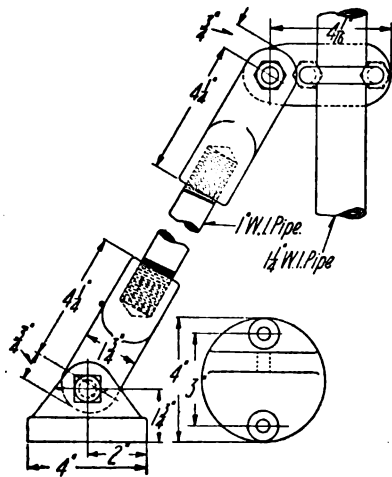


FIG. 87

Style No. Description  
180398 Wall or floor brace complete.

Approximate shipping weight, 10 pounds.

Angle-iron frame mounting brace, heavy duty U-bolt type—Style No. 291181, covers complete brace with 4-foot length of pipe for left-hand side of panel; style No. 306796 for right-hand side of panel.

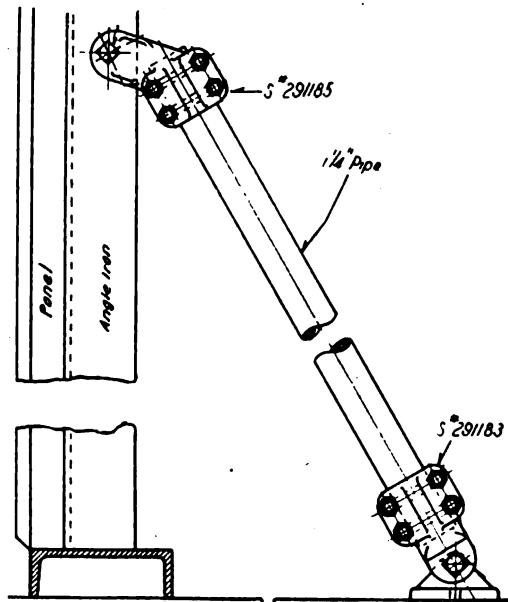


FIG. 91

Pipe frame mounting brace, heavy duty U-bolt type—Style No. 299188, covers complete brace with 4-foot length of pipe.

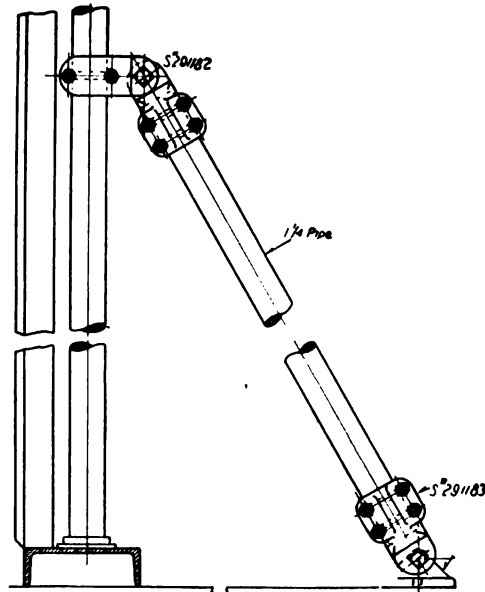


FIG. 88

Pipe ends—These cast iron pipe ends are tapped with a straight thread of standard size, and are suitable for bolting to the angular flanges or to angular pipe tees. Straight thread is utilized to obtain adjustment between points of attachment.

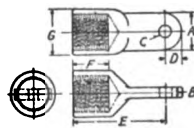


FIG. 89

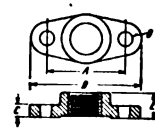


FIG. 90

Pipe End Style No.	Size Pipe In.	FIG. 89, DIMENSIONS IN INCHES						
		A	B	C	D	E	F	G
83129	3/4	1 1/4	1 1/2	1 1/2	3/8	3	1 1/2	1 3/8
162517	1	1 3/4	1 3/4	1 3/4	3/4	4 1/4	1 1/2	1 3/4
128597	1 1/4	1 3/4	1 3/4	1 3/4	3/4	4 1/4	1 3/4	2 1/8

Approximate shipping weight, 1 pound.

Pipe flange, tapped type—These flanges are made of malleable or cast iron and are tapped to receive pipe with standard pipe thread. The 1 1/4-inch flange is also used as the floor flange on types J and L switchboard frames.

Pipe Flange Style No.	Size Pipe Inches	Material of Flange	FIG. 90, DIMENS. IN INCHES				
			A	B	C	D	E
162512	3/4	C. I.	2 3/8	3/8	3/8	3 1/4	3/4
225654	1 1/4	M. I.	3 3/8	3/8	3/8	4 1/4	1 1/4
162510	2	C. I.	5	3/4	3/4	6 1/4	1 1/2

Approximate shipping weight, 1 pound.

Order by Style Number



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Pipe brace clamp, One-U-bolt type**—For ordinary applications. These brace clamps are made of malleable iron and are clamped to pipe structure by means of U-bolts. Fig. 92 shows the clamp bracing a 1¼-inch pipe to angle-iron frame.

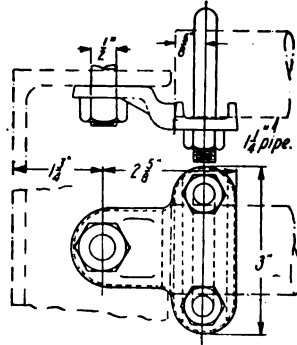


FIG. 92

Style No.  
226471 Pipe brace clamp with bolts.  
Approximate shipping weight, 1 pound.

**Pipe brace clamp, Two-U-bolt type**—These are clamped to pipe structure by means of two U-bolts. Style No. 291184 covers the straight clamp complete and style Nos. 291185 and 297595 cover right and left hand offset clamps. Style No. 303509 covers clamp for wall end. Style No. 303540 is Style No. 303509 with addition of U-bolt for clamping to pipe instead of to wall.

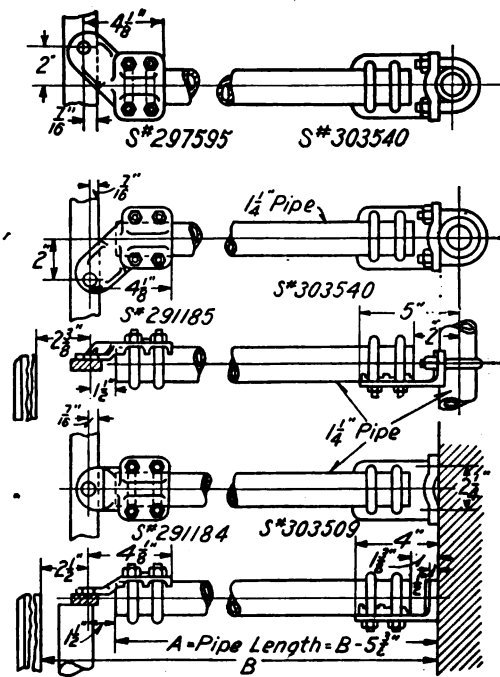


FIG. 95

Order by Style Number

**Pipe mounting bracket**—This bracket is made of cast iron and is designed to be clamped to 1¼-inch pipe by means of U-bolt and to support straps or similar parts on the pipe frame.

Style number includes strap and mounting bolt.

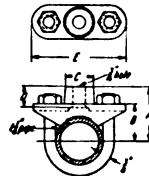


FIG. 93

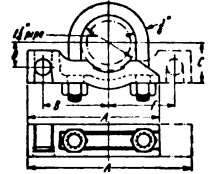


FIG. 94

FIG. 93, DIMENSIONS IN INCHES					
Bracket Style No.	A	B	C	D	E
112878	1 1/2	1 1/4	1 1/2	1 1/2	3 1/4

Approximate shipping weight, 1 pound.

**Pipe clamping brackets, for top iron of frame structure**—These brackets are of cast iron and are designed to clamp on the top end of 1¼-inch pipe upright, forming part of a type J or L switchboard frame, and for holding the top iron of the frame to the pipe upright.

Style No. 223577 is for end bracket.

Style No. 223578 is for intermediate bracket.

Style number includes brackets and clamping bolts.

FIG. 94, DIMENSIONS IN INCHES						
Bracket Style No.	A	B	C	D	E	F
223577	4 1/4	2	1 1/2	1 1/2	1	2
223578	5	2	1 1/2	1 1/2	1	2

Approximate shipping weight, 1 pound.

**Wall brace complete with angular adjustment light duty type**—The brace consists of a wall clamp of the U-bolt type, one piece of 3/4-inch wrought iron pipe, 4 feet long, and a pipe brace clamp of the U-bolt, see Fig. 98.

Style No. 225110 includes Style Nos. 226445 and 226473 with U-bolts and 4 feet of 3/4-inch pipe.

**Pipe brace clamp, U-bolt clamp type, with angular adjustment**—These brace clamps are made of malleable iron and are clamped to pipe structure by U-bolts. The brace end of the clamp is provided with suitable openings so that the brace pipe may be clamped at any desired angle to main pipe, angle iron, floor or wall. Fig. 97 shows the clamp for bracing to another pipe. Fig. 96 to switchboard angle iron frame, and Fig. 99 to floor or wall.

Style number includes clamp complete with U-bolts.

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

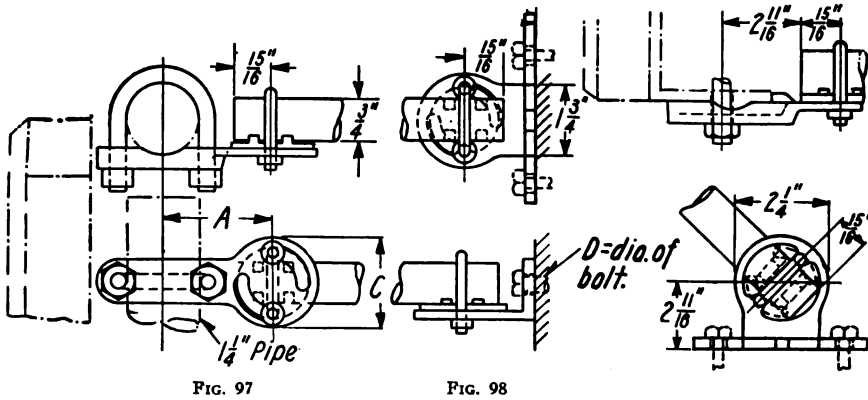


FIG. 96

FIG. 99

Clamp Style No.
226445
238998
238706
226444
226473
253700

Figure
97
100
97
96
99
101

Size of Pipe Inches
3/4
1 1/4
3/4
3/4
3/4
1 1/4

Brace To
1 1/4-Inch Pipe
1 1/4-Inch Pipe
2-Inch Pipe
3-Inch Angle Iron
Floor or Wall
Floor or Wall

DIMENSIONS IN INCHES			
A	B	C	D
2 1/4	1 1/8	2 1/4	..
2 3/4	1 1/8	3 1/2	..
3 1/8	1 1/8	2 1/2	..
2 3/4	1 1/8	2 1/4	..
1 1/8	1 1/8	2 3/8	3/8
....	....	....	....

Approximate shipping weight, 6 pounds.

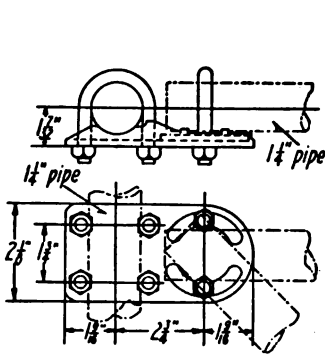


FIG. 100

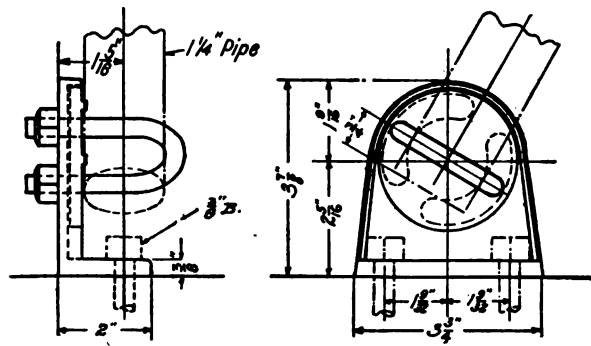


FIG. 101

**Barrier brackets, for pipe mounting—**  
These cast iron brackets are designed to support asbestos lumber or Micarta barriers on a pipe frame structure.

**Style number** includes bracket and U-bolt.

Barrier Bracket Style No.	Figure	DIMENSIONS IN INCHES					
		A	B	C	D	E	F
239027	102	2 1/4	1 1/8	3	7/8	1	1/2
239028	103	1 1/4	2 1/4	4 1/4	3/8	1 1/4	..

Approximate shipping weight, 1 pound.

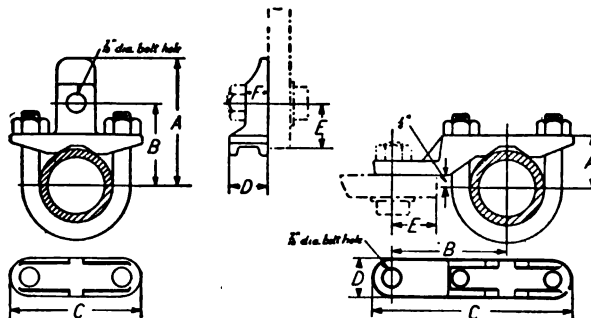


FIG. 102

FIG. 103

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Mounting brackets for pipe panels**— These brackets are clamped on the pipe structure by U-bolts and are designed particularly to support the switchboard panels of types J and L frames. Right hand, left hand and intermediate brackets are listed. The left hand bracket is mounted in opposite direction to right hand bracket; the intermediate bracket consists of a right hand bracket and left hand bracket bolted together by standard machine bolts.

Style number includes bracket and bolts.

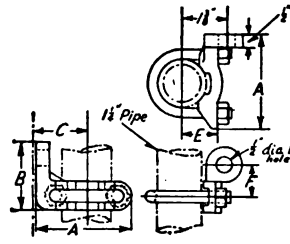


FIG. 104

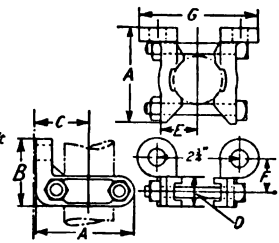


FIG. 105

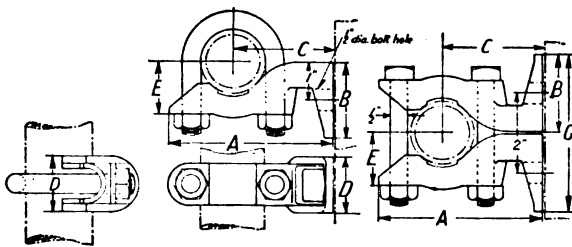


FIG. 106

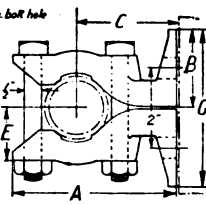


FIG. 107

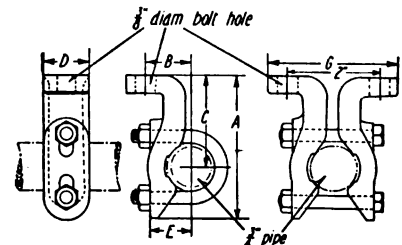


FIG. 108

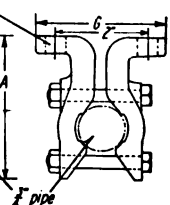


FIG. 109

Mounting Bracket Style No.	Direction of Mounting	Figure	Size of Pipe, Inches
223579	Left Hand	104	1 1/4
223580	Right Hand	104	1 1/4
223581	Intermediate	105	1 1/4
228889	Right or Left	106	1 1/4
228890	Intermediate	107	1 1/4
239021	Right or Left	108	3/4
239022	Intermediate	109	3/4

Approximate shipping weight, 1 pound.

DIMENSIONS IN INCHES						
A	B	C	D	E	F	G
3 3/8	2 1/4	1 3/4	...	1 1/8	1 1/8	...
3 3/8	2 1/4	1 3/4	...	1 1/8	1 1/8	...
3 3/8	2 1/4	1 3/4	1	1 1/8	1 1/8	4
4	1 1/8	2 1/4	1 3/8	1 1/8	...	...
4	1 1/8	2 1/4	...	1 1/8	...	3 3/8
2 1/4	1	2	1	1 1/8	...	...
...	...	...	...	...	...	2 3/8

**Pipe cross clamps**—These clamps are made of malleable iron and are clamped to the pipe frames by U-bolts. They are shaped symmetrically on each side, which permits the right angularly positioned pipes to be located in line with each other, or the pipes may be crossed as shown in Fig. 115. This clamp may be used as a pipe tee, a pipe elbow, or a pipe cross. Clamps holding pipes on either side of a perpendicular pipe will not interfere with each other, thus allowing great flexibility in design of pipe structures; see Fig. 111.

Style number includes clamp complete with two U-bolts.

Table for Fig. 111

Clamp Style No.	Size of Pipe Inches	DIMENSIONS IN INCHES		
		A	B	C
216511A	3/4 x 3/4	1 1/4	1 3/4	1 1/4
216510A	3/4 x 1	1 1/4	2 1/4	1 1/4
216509A	1 1/4 x 1 1/4	2 1/4	2 1/4	2 1/4
238703	1 1/4 x 2	2 1/4	2 1/4	2 1/4
238702	2 x 2	3	3	3 3/8

Approximate shipping weight, 1 1/2 pounds.

**Caps for ends of pipes.**

Cap Style No.	Size of Pipe
240529	3/4
240530	1 1/4
240531	2

Approximate shipping weight, 1 pound.

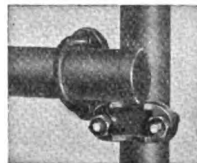


FIG. 110

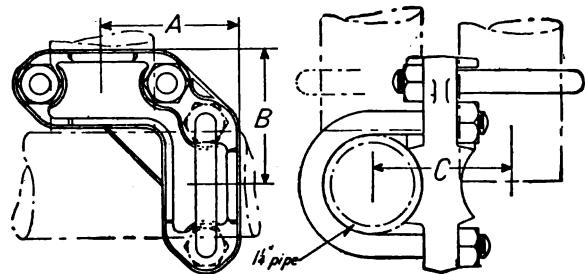


FIG. 111

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Pipe cross clamps**—This is a double one-piece clamp for use about the structure to give it additional rigidity.

Table for Fig. 113

Style No.	Size of Pipe Inches	DIMENSIONS IN INCHES			Approx. Shipping Wt., Lbs.
		A	B	C	
291178	1 1/4 x 1 1/4	4 5/8	4 5/8	1 3/4	1
291179	1 1/4 x 2	5 3/8	5 1/8	1 3/4	1
291180	2 x 2	6	6	1 3/4	1

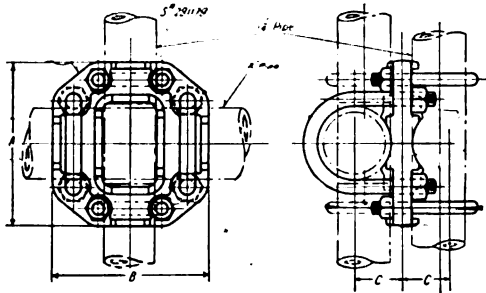


FIG. 113

**Pipe cross clamps, three to six-way, U-bolt clamp type**—These clamps are made of malleable iron and are similar to the cross clamps, except that an additional clamping fixture is provided. The clamp as shown constitutes a three-way clamp, but by suitably combining two or more clamps and substituting straight bolts in place of U-bolts where required, four to six-way clamps may be made up.

**Style number** includes one clamp complete with three U-bolts.

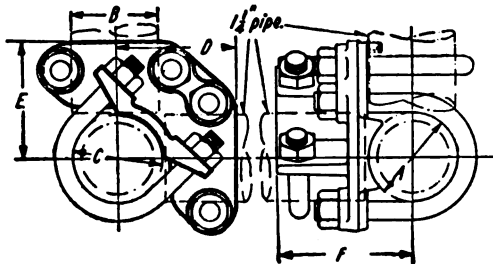


FIG. 115

Clamp Style No.	DIMENSIONS IN INCHES						Approx. Shipping Wt. Lbs.
	PIPE SIZES			D	E	F	
	A	B	C				
223411	1 1/4	1 1/4	1 1/4	2 1/4	2 1/4	2 3/8	2
238705	2	1 1/4	1 1/4	2 1/4	2 1/4	3 1/8	2
238704	2	2	2	3	3	3 1/4	2

**Pipe flange clamps** are made of malleable iron and are clamped to the pipe frame by U-bolts.

**Style number** includes pipe flange complete with U-bolt.

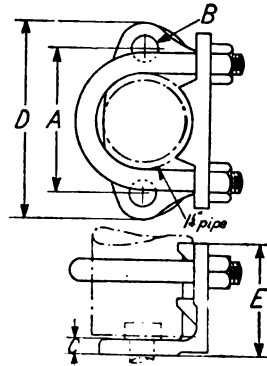


FIG. 112

Pipe Flange Clamp Style No.	Size of Pipe Inches	DIMENSIONS IN INCHES					Approx. Shipping Wt. Lbs.
		A	B	C	D	E	
226443	1 1/4	2 1/8	3/8	1/8	3 1/8	2	1
238707	2	4 1/2	3/2	3/8	5 1/2	2 1/8	1

**Clamp for 1 1/4-inch pipe**—Base to wall, pipe parallel to wall, Fig. 114 (Style No. 291187).

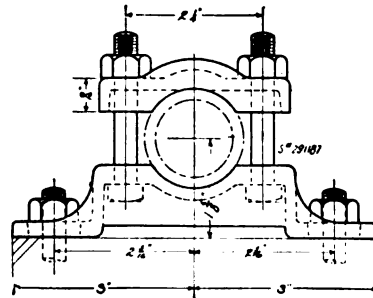


FIG. 114

**Mounting clamp brackets for pipe or angle iron** frame, cast with slot in end lug, designed for general mounting. This bracket may be used as part of rheostat idlers, shown in Figs. 118 and 119.

**Style number** includes bracket and mounting bolt.

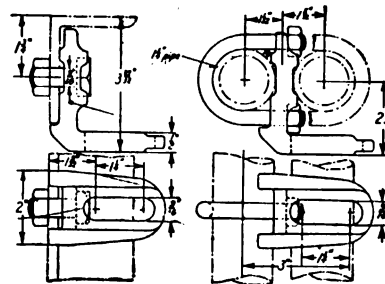


FIG. 116

FIG. 117

**Style No. 216449** Description: Pipe mounting bracket, Fig. 116, for angle iron mounting.

**216450** Pipe mounting bracket, Fig. 117, for frame mounting.

Approximate shipping weight, 1 lb.

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Idler brackets with idlers are of cast iron, designed for mounting on angle iron or pipe frame construction, for guiding sprocket chain transmission on rear of switchboard panel, for remote control of rheostats. Various methods of arranging sprockets and chains may be applied with the use of these idler brackets.

Style number includes idler bracket, idler and mounting bolt.

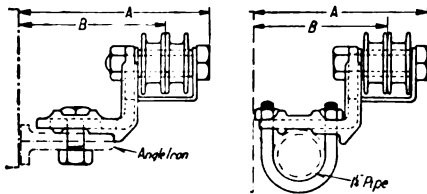


FIG. 118

FIG. 119

Idler Bracket Style No.	Frame Mounting	Figure	DIMENSIONS IN INCHES		Approx. Shipping Wt., Lbs.
			A	B	
216451	Angle Iron	118	6 1/4	4 3/4	2
216452	1 1/4 Inch Pipe	119	6 1/4	4 3/4	2
216453	1 1/2 Inch Pipe	119	9 1/4	8	2

Shunt lead holder — For mounting on rear of board to take up slack shunt leads.

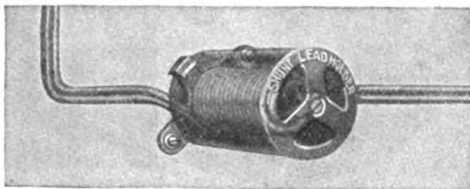


FIG. 120

Style No.	Approx. Shipping Weight, Lbs.
291177	2

U-bolts for wrought iron pipe are listed in iron and brass.

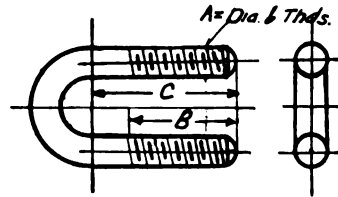


FIG. 121

Style No.	Size of Pipe	DIMENSIONS IN INCHES			Radius
		A	B	C	

IRON BOLTS

127932	1 1/4	1 1/2-13	3/4	3 1/4	.....
124586	1 1/4	1 1/2-13	1 1/4	1 1/4	.....
127800	1 1/4	1 1/2-13	1 1/4	2 1/4	.....
127933	1 1/4	3/8-16	1	1 1/4	.....
210697	1 1/4	3/8-16	1 1/4	2	.....
192929	3/4	1/2-18	1	2 3/4	.....
192930	3/4	1/2-18	1	1 3/4	.....

BRASS BOLTS

247149	.....	3/8-16	1 1/4	1	1 1/4
247150	.....	3/8-16	1 1/4	1	1 1/4
247151	.....	3/8-16	1 1/4	1 1/4	1 1/4
247152	.....	3/8-16	1 1/4	1 1/4	1 1/4
247153	.....	3/8-16	2 1/4	1	1 1/4
247154	.....	3/8-16	1 1/4	1	1 1/4
247155	.....	1/2-20	1 1/4	3/4	1 1/4
247156	.....	1/2-20	1 1/4	3/4	1 1/4
247157	.....	1/2-18	1 1/4	3/4	1 1/4
247158	.....	1/2-18	1 1/4	3/4	1 1/4
247159	.....	1/2-20	1 1/4	3/4	1 1/4
247160	.....	1/2-20	1 1/4	3/4	1 1/4

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

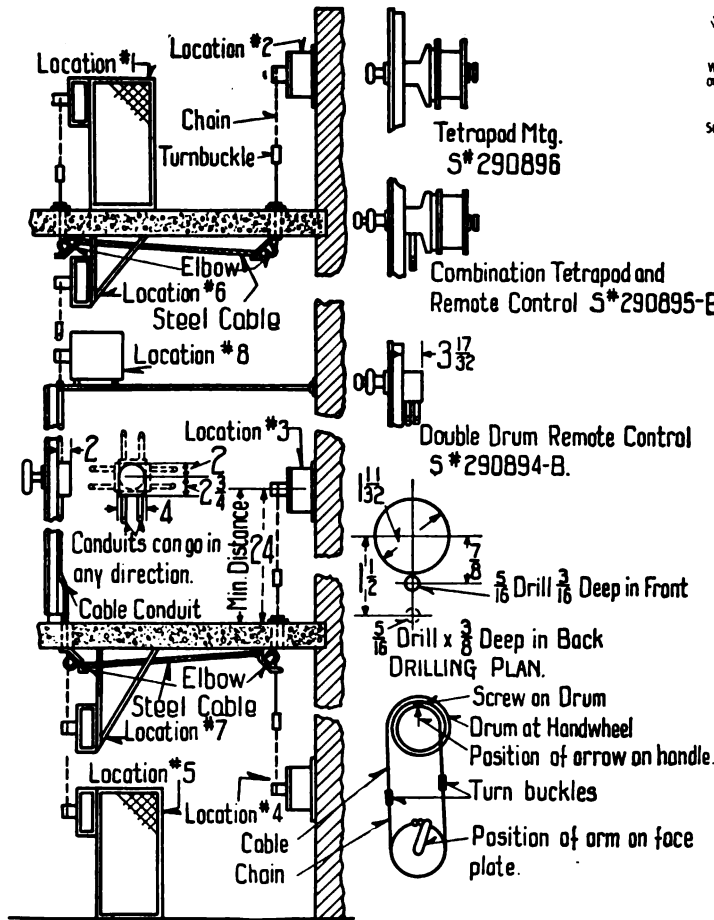


FIG. 124

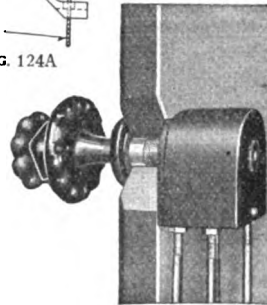
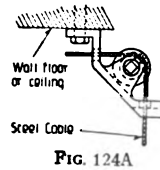


FIG. 122

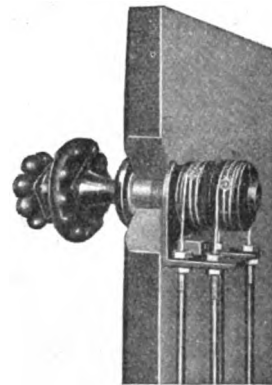


FIG. 123

**Switchboard mountings and control mechanisms for rheostats**—The tetrapods for supporting rheostats (with 4 mounting bolts) at the switchboard will accommodate rheostats with a minimum of 5 3/4 inches and a maximum of 11 1/4 inches between bolt centers. Remote hand-control rheostats are operated from the handwheel on the front of the switchboard through a system of drum and cable transmission at the switchboard to a chain and sprocket at the rheostat. At the switchboard, the cable is enclosed in pipe conduit, thus eliminating all danger of short circuits on the panel due to a broken chain or cable falling against the connections.

The handwheels are made of black moulded material and have a black highly polished finish.

**Cable conduit** may be run from the cable drum housing at the panel to a point not less than 2 feet from the sprocket at the rheostat. Conduit should be 1/2-inch pipe with smooth inside surfaces and all ends reamed to prevent abrasion of cable. Conduit may be bent for small angles on a radius of not less than 6 inches. For 90-degree bends use roller elbows. Extra roller elbows and conduit which are provided

with mounting holes, may be ordered as required. Conduit should be supported at bends.

**Cable adjustment and installation**—At the middle point of the cable, open the strands and fasten to the drum with screw and washer as provided. Arrange drum, handwheel, sprocket, turnbuckles, chain and cable in relative position as shown in sketch, tighten turnbuckles to take up slack. With pointer vertical, rheostat resistance to be all out, turn handwheel to right until other extreme position is reached and mark position of the pointer on dial plate.

**Style number** for remote-control mechanism includes (in addition to mechanisms mounted on the switchboard panels) cable, chain, 2 turnbuckles, and four 1/2-inch pipe roller elbows for 10-foot run between drum at the panel and sprocket at the rheostat. The **style number** does not include the rheostat, rheostat sprocket, or 1/2-inch pipe conduit.

Style No.	Description	Approx. Shp. Wt., Lbs.
290893	Single Handwheel—Remote Control	5
290894	Double Handwheel—Remote Control	8
290895	Double Handwheel—Combination Tetrapod and Remote Control	20
290896	Single Handwheel—Tetrapod Mounting	15
290897	Elbow	1

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Shunt**—Supporting brackets of cast iron for supporting Westinghouse type G ammeter shunts on the rear of switchboard panels are intended to relieve the shunt of the weight of the outgoing cable. The style numbers include the necessary screws and screw anchors for attaching supports to panel.

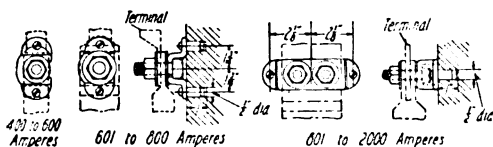


FIG. 125

- Style No.  
**303267** For 460 to 600 ampere shunts.  
**303268** For 601 to 800 ampere shunts.  
**303269** For 801 to 2000 ampere shunts.

**Meter swivel brackets** suitable for any Westinghouse round type meters, 7 inches or 9 inches diameter, and are intended for mounting in upright position on top of iron structure of types E, G, J or L switchboard frames. Bracket is swiveled so that the face of the meter may be turned in any desired position.

Style number and list price include bracket and mounting bolts, as shown in full lines.

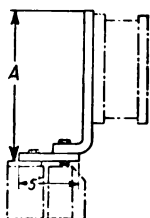


FIG. 127

Swivel Bracket Style No.	Size of Meter, Inches	Dimension A, Inches
164970	9	11 3/4
168824	7	9 3/4

Approximate shipping weight, 5 pounds.

**Meter swivel brackets** for mounting one Westinghouse illuminated dial meter on top iron of frame construction of types E, G, J or L switchboard frames.

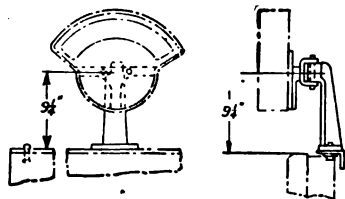


FIG. 128

- Style No.  
**239799** Meter swivel bracket with mounting bolts.  
 Approximate shipping weight, 5 pounds.

**Meter swivel brackets** suitable for mounting 3 or 4 Westinghouse round type meters, 7 inches diameter, on the top iron of frame structure of types E, G, J or L switchboard frames.

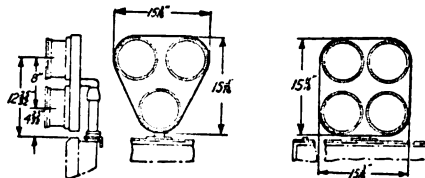
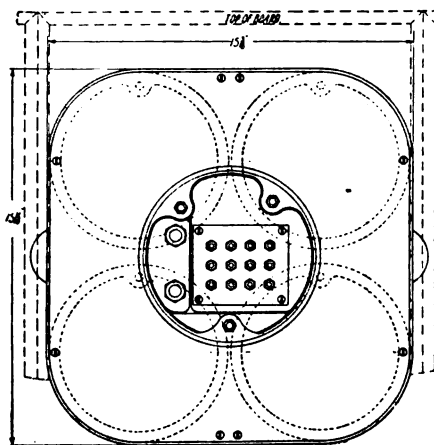
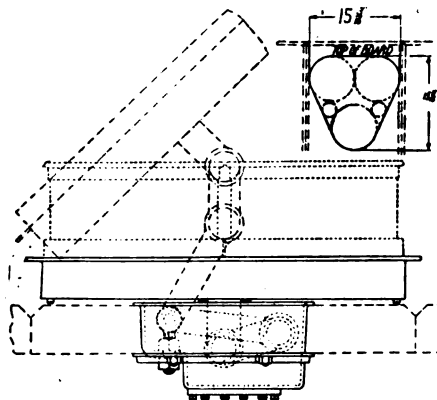


FIG. 126

- Style No.  
**239179** Meter swivel bracket with mounting bolts for mounting three meters.  
**239178** Meter swivel bracket with mounting bolts for mounting four meters.  
 Approximate shipping weight, 15 pounds.

**Meter swivel brackets** for mounting Westinghouse round type meters of 7 inches diameter, except for polyphase wattmeters, on face of switchboard panel. These brackets may be turned at various angles to face of panel or pushed back when desired.

- Style No.  
**238991** Bracket complete for three meters, Fig. 129.  
**238992** Bracket complete for four meters, Fig. 130.  
 Approximate shipping weight, 20 pounds.



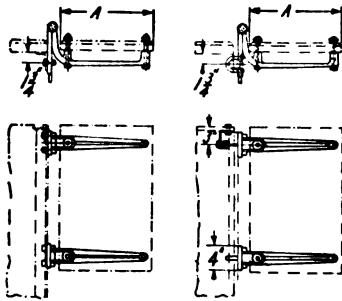
FIGS. 129 AND 130

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Panel swinging brackets designed for mounting a 1½-inch swinging panel. The bracket is hinged so that the face of the panel may occupy any desired position from one parallel to the face of the board to one at right angle to switchboard. When used with switchboard pipe frame, the brackets must be located so as to clear panel mounting bracket.

Style number includes bracket with the necessary mounting bolts.



ANGLE IRON MOUNTING PIPE MOUNTING

FIG. 131

Swinging Bracket Style No.	Width of Panel Dimension A	Frame Mounting	Approx. Shipping Wt., Lbs.
	Inches		
217863	12	Angle Iron	10
217864	16	Angle Iron	10
217865	20	Angle Iron	10
217866	24	Angle Iron	10
217867	12	Pipe	10
217868	16	Pipe	10
217869	20	Pipe	10
217870	24	Pipe	10

Meter swinging bracket for Westinghouse illuminated dial meters.

Style number and list price include bracket and mounting bolts.

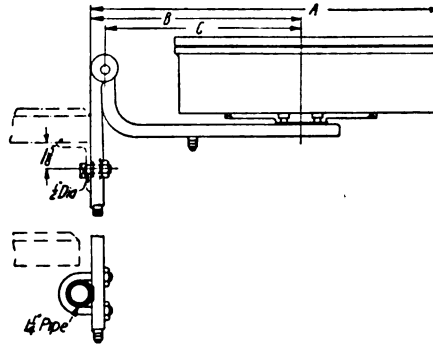


FIG. 132

Bracket Style No.	Frame Mounting	DIMENSIONS IN INCHES			Approx. Shipping Wt., Lbs.
		A	B	C	
177513	Angle Iron	21	12 3/4	11 1/4	10
238990	1 1/4-Inch Pipe	21	12 3/4	11 1/4	10

Meter swinging bracket suitable for any Westinghouse round type, 7-inch or 9-inch meters except polyphase wattmeters. Bracket is hinged so that the face of the meter may occupy any desired position from one parallel to the plane of the board to one at right angles to the board.

Style number includes bracket and mounting bolts.

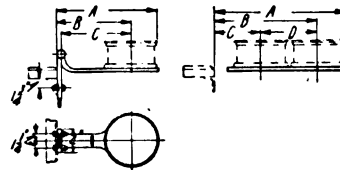


FIG. 133

Swinging Bracket Style No.	Size of Meter, Inches	Number of Meters per Bracket	Frame Mounting	DIMENSIONS IN INCHES			
				A	B	C	D
217858	9	1	Angle Iron Frame	18	13	12 1/4	..
217861	9	2	Angle Iron Frame	23	18	8	10
217859	9	1	1 1/4-Inch Pipe	18 1/4	13 1/4	12 1/4	..
217862	9	2	1 1/4-Inch Pipe	23 1/4	18 1/4	8 1/4	10
217852	7	1	Angle Iron	14 3/4	10 1/2	9 1/4	..
217855	7	2	Angle Iron	18 3/4	14 1/2	6 1/2	8
217853	7	1	1 1/4-Inch Pipe	15 1/4	11 1/4	9 1/4	..
217856	7	2	1 1/4-Inch Pipe	19 1/4	15 1/4	7 1/4	8

Order by Style Number



SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

**Metal Switchboard Caps**—These caps are used for covering holes in panels drilled for future installation of apparatus.

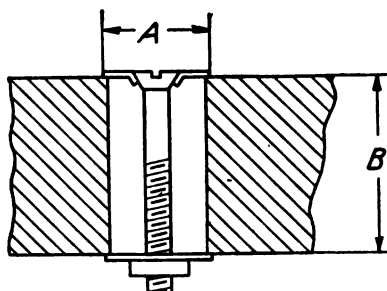


FIG. 134

Style No.	DIMENSIONS IN INCHES	
	A	B
282799	1 1/4	2
282800	1 1/2	2
282801	1 3/4	2
282802	1 3/4	1 1/4
282803	1 3/4	1 1/2
282804	1 3/4	1 1/2
282805	1 3/4	2
282806	1 3/4	2
282807	2 1/4	2
282808	3 1/4	2
282809	4 1/4	2
285459	1 1/4	1 1/4
285460	1 1/4	1 1/2
285461	2 3/4	1 1/2
285462	3 1/4	1 1/2
285463	4 1/4	1 1/2

**Uninsulated bolts** for types E, G, L, and J switchboard frames. Style number includes bolt with soft rubber washer, standard hexagon nut and black marine finished bolt head and washer for front of panel.



FIG. 137

Style No.	Length of Bolt, Inches	THICKNESS OF PANEL, IN.	
		Pipe Frame	Angle Frame
253102	2	3/4	1
253103	2 1/4	1	1 1/4
253104	2 1/4	1 1/4	1 1/2
253105	2 3/4	1 1/2	...
253108	3	...	2
253107	3 1/4	2	...
253108	3 1/4	2	2 1/4
253109	3 3/4	2 1/4	...
253110	4	3	3
253111	4 1/4	3	...

**Insulated bolts for types E, G, L and J switchboard frames**—Style number includes bolt with fiber bushing, rubber washer and black marine finished bolt head and washer.

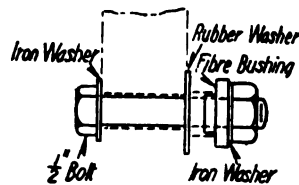


FIG. 135

Style No.	Length of Bolt, Inches	THICKNESS OF PANEL, IN.	
		Pipe Frame	Angle Frame
253112	2 1/4	3/4	1
253113	2 3/4	1	1 1/4
253114	2 3/4	1 1/4	1 1/2
253115	3	1 1/2	...
253116	3 1/4	...	2
253117	3 3/4	2	...
253118	3 3/4	...	2 1/4
253119	4	2 1/4	...
253120	4 1/4	...	3

**Fancy hexagon nuts, black marine finish**, may be used with the bolts just described, or any standard iron bolt.

Style number applies to nuts finished in black marine.



FIG. 136

Style No.	Diameter Bolt, Inches	Threads per Inch
7559-A	1/8	16
7560	1/2	13

**Beveled washers, black marine finish**, are for use with nut shown in Fig. 136.

Style No.	Diameter Bolt	Thickness
3379	3/4	1/4
3380	1/2	1/8

**Card holders**—These card holders are designed for mounting on the front of panels to hold cards giving name of the machines or circuits controlled, and are finished in black marine.



FIG. 138

Style No.	Overall Dimensions in Inches	Size of Opening in Inches
55190-A	2 1/2 x 1 1/4	1 1/4 x 3/4
55191-A	3 x 1 1/4	2 1/4 x 3/4

Order by Style Number

SWITCHBOARD DETAILS AND INDOOR BUS-SUPPORTS—Continued

Calibrating terminals for secondary circuits—For conveniently making connections for the calibration of instruments. The thumb nuts are made of insulating material.

Style No.	Description
281442	One Current Coil Terminal*
275934	One Removable Link
281443	One Voltage Coil Terminal.

\*Includes one stud only with necessary nuts and terminals.

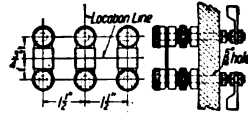


FIG. 139 CURRENT COIL TERMINAL

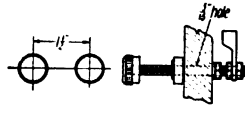


FIG. 140 VOLTAGE COIL TERMINAL

Terminal Posts for Switchboard Small Wiring

Figure 141 shows a convenient and inexpensive terminal post for terminating the small wiring on rear of switchboard panels. The post provides one set of crimp washers and lock-nuts for the permanent connections from the panel, and another set for the outgoing lead. These posts are set directly in the rear of the panel with a setting tool and are intended to be located when the wiring of the panel is done. Each post requires a hole in the panel 5/16-inch diameter and 3/4-inch deep.

Style No.	Description
280279	Terminal Post
281441	Setting Tool



FIG. 141

Order by Style Number

NAMEPLATES

Nameplates on the switchboard for identifying the switchboard apparatus with the circuits or machines controlled, add materially to the security of operation. The nameplates here listed are 3 inches wide and 1 inch high, are fastened to the panels with brass escutcheon pins and are neat and

pleasing in appearance. The letters and rim are polished copper on black matt.

Order by nameplate number. Nameplates with other lettering than here listed will be supplied as ordered at a list price of \$35.00 for first plate and 60c for each duplicate plate.

Lettering on Nameplate	Nameplate No.	Lettering on Nameplate	Nameplate No.
A-C. Rotary No. 1	1172	Building No. 4	2350
A-C. Generator Field	1928	Bridge	2279
A-C. Generator	1938	Calibrating Voltmeter	3471
Air Compressor	1797	Car Department	2839
Air Pressure	1974	Channel	2276
Air Pump	1847	Charge	3044
Alternating Current, Light	796	Circuit No. 1	3614
Alternating Current, Power	797	Circuit No. 2	3615
Alternating Current, Street Service	870	Circuit No. 3	3616
Arc Lights	2792	Circuit No. 4	3617
Auditorium	821	Circuit No. 5	3618
Auxiliary Bus	3017	Circuit No. 6	3619
Auxiliary Bus Running	3024	Circuit No. 7	3620
Auxiliary Bus Starting	3025	Circuit No. 8	3621
Bal. Coil No. 1	883	Circuit No. 9	3622
Bal. Coil No. 2	884	Circuit No. 10	3623
Basement	1771	Circuit No. 11	3624
Battery	3045	Circuit No. 12	3625
Boiler Feed Pump	862	Circuit No. 13	3626
Boiler House	2353	Circuit No. 14	3627
Boiler Room	2262	Circuit No. 15	3628
Building No. 1	2347	Circuit No. 16	3629
Building No. 2	2348	Circuit No. 17	3630
Building No. 3	2349	Circuit No. 18	3631

(Continued on next page)

## SWITCHBOARD DETAILS—Continued

Nameplates—Continued			
Lettering on Nameplate	Nameplate No.	Lettering on Nameplate	Nameplate No.
Circuit No. 19.....	3632	Light.....	2795
Circuit No. 20.....	3633	Lights.....	2424
Circuit No. 21.....	3634	Light Main.....	2663
Circuit No. 22.....	3635	Lighting System.....	2646
Circuit No. 23.....	3636	Line No. 1.....	947
Circuit No. 24.....	3637	Line No. 2.....	958
Circuit No. 25.....	3638	Line No. 3.....	959
Circulating Pump.....	1856	Line No. 4.....	961
Control No. 1.....	3046	Local Feeders.....	3154
Control No. 2.....	3047	Local Service.....	2823
Control No. 3.....	3048	Main Bus.....	3015
D-C Panel.....	935	Main Bus Running.....	3022
D-C Rotary No. 1.....	1171	Main Bus Starting.....	3023
D-C Street Service.....	887	Main Control.....	1712
Direct Current Generator.....	812	Main Light Breaker.....	1822
Direct Current Laboratory.....	810	Main Light Switch.....	3514
Direct Current, Power.....	811	Main Line.....	1462
Discharge.....	3043	Main Power Breaker.....	1823
Dredger.....	3070	Main Power Switch.....	3515
Emergency Line.....	2644	Main Switch.....	1798
Emergency Switch.....	2417	Motor.....	2230
Emergency Switches.....	2698	Motors.....	2354
Equalizer.....	888	Motor Circuit.....	2642
Equalizer Rheostat.....	2775	Motor Generator, Running.....	867
Equalizer Switch.....	3457	Motor Generator, Starting.....	868
Exchange.....	3069	Motor No. 1.....	2027
Engine Generator, Field.....	806	Motor No. 2.....	2028
Engine Generator.....	799	Negative.....	814
Exciter.....	2181	Negative D-C, Generator.....	882
Exciter Bus.....	3016	Neutral Switches.....	1434
Exciter No. 1.....	816	Night Lights.....	1855
Exciter No. 2.....	817	No. 1 Feeder Circuit.....	1939
Exciter No. 3.....	2684	No. 2 Feeder Circuit.....	1940
Exciters.....	815	No. 1 Motor.....	2696
Exhaust Fan.....	1689	No. 2 Motor.....	2697
Fans.....	1467	No. 3 Motor.....	2758
Fan No. 1.....	1685	No. 4 Motor.....	2759
Fan No. 2.....	1686	No. 1 Rotary.....	2243
Feeder No. 1.....	2029	Panel A.....	1824
Feeder No. 2.....	2030	Panel B.....	1825
Feeder No. 3.....	2031	Panel C.....	1826
Fire Pump.....	2566	Panel D.....	1827
General Power Circuit.....	2565	Panel E.....	1828
Generator.....	2182	Panel F.....	1829
Generator No. 1.....	1682	Panel G.....	1830
Generator No. 2.....	1683	Panel H.....	1831
Generator No. 3.....	1981	Panel J.....	1832
Generator No. 4.....	2820	Panel No. 1.....	1697
Generator No. 5.....	2817	Panel No. 2.....	1698
Generator No. 6.....	2814	Panel No. 3.....	1699
Generator Voltmeter Switch.....	3477	Positive.....	813
Ground Detectors.....	2800	Positive A-C, Generator.....	880
Ground Detector Lamps.....	3479	Power.....	3510
Gymnasium.....	2645	Power Feeder No. 1.....	2023
Incoming.....	2355	Power Feeder No. 2.....	2022
Incoming Line.....	2797	Power Feeder No. 3.....	2021
Laboratory.....	1470	Power Feeder No. 4.....	2024
Laundry.....	3517	Power Feeder No. 5.....	2025

(Continued on next page)

SWITCHBOARD DETAILS—Continued

Nameplates—Continued			
Lettering on Nameplate	Nameplate No.	Lettering on Nameplate	Nameplate No.
Power Feeder No. 6	2026	Transformer Bank No. 2	2637
Power House Lighting	2563	Transformer Bank No. 3	2825
Power House Lights	1178	Transformer Bank No. 4	2819
Power Line	2639	Transformer Bank No. 5	2816
Power Main	2661	Transformer Bank No. 6	2813
Pump No. 1	952	Transformer and Line No. 1	3152
Pump No. 2	955	Transformer and Line No. 2	3153
Pump No. 3	956	Turbine Generator	798
Pump No. 4	957	Valve Control	944
Pump No. 5	2486	Voltage Regulator	3151
Rotary	2229	Water Pressure	1973
Running Position	1220	Water Pump	2183
Second Position	2751	1st Floor	2491
Service Light	2550	2d Floor	1773
Service Power	2546	3d Floor	1774
Single Phase Teaser Transformer	2647	4th Floor	1775
Single Phase Transformer	2648	5th Floor	1776
Spare Transformer	2638	6th Floor	1777
Starting Position	1219	7th Floor	1778
Storage Battery	3150	8th Floor	1779
Supply	1857	9th Floor	1780
Synchronous Motor	1925	10th Floor	1781
Synchronous Motor	1941	10 K. W. Exciter	2847
Transformer	2798	20 K. W. Exciter	2848
Transformer No. 1	1174	35 K. W. Exciter	1923
Transformer Bank No. 1	2636	50 K. W. Exciter	1937

BUS-BAR COPPER

Copper straps suitable for bus and strap connections are listed below. The straps are hard, cold rolled or drawn to size; they have a conductivity of 98 per cent of Matthiesson's standard and are supplied in lengths of from 10 to 14 feet.

As a general indication of the amount of copper required for any particular connection, the carrying capacity of single-strap and two-strap connections is given in the table below. These values are not good for more than two straps in one connection, for above this, the conditions of installation, such as spacing between straps and spacing between adjacent bus-bars for alternating current, greatly affect the temperature rise.

Briefly, the capacity of the bus is increased by making the spacing between straps of the same bus greater, amounting to an increase of approximately 25 per cent for 1/4-inch spacing, instead of 1/8-inch spacing. On alternating current buses, mounted adjacent to each other, the mutual induction of returning circuits increases the heating greatly.

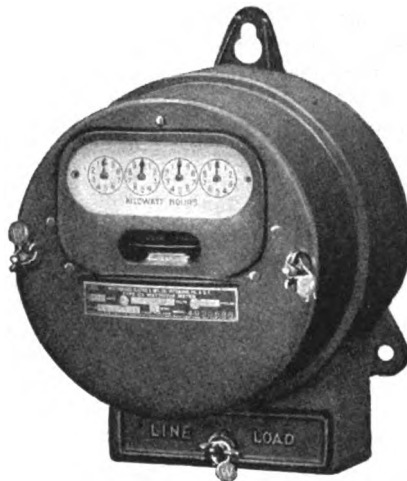
Attention is called to the fact that straps 1/8-inch in thickness should be used rather than half the number of 1/4-inch straps, as the radiating surface is greater.

Prices will be quoted on application.

SIZE OF STRAP		Weight in Pounds per 1000 Feet	CARRYING CAPACITY Amperes 30 degrees C Rise	
Thickness, Inches	Width, Inches		One Strap, A-C or D-C, Amperes	Two Strap, D-C, 1/4 inch Space between Straps, Amperes
1/8	1/2	240	100	....
1/8	1	240	150	....
1/8	1	480	200	....
1/8	1 1/2	720	300	....
1/8	2	960	400	....
1/8	2	1925	550	....
1/8	3	1440	600	1075
1/8	3	2885	850	1500
1/8	4 1/2	2165	925	1600
1/8	4 1/2	4330	1250	2250
1/8	6	2885	1225	2125

## TYPE OA WATTHOUR METERS

### ALTERNATING CURRENT



SINGLE-PHASE METER

Low maintenance cost and long-life accuracy are features equal in importance to initial accuracy. This fact has been kept in mind in developing and constantly improving the type OA meters. The permanence of the calibration of these meters results in the least loss of revenue from inaccuracy, and entails the least cost for service tests. Their durable mechanical construction minimizes the renewal of parts.

#### Operation

The type OA watt-hour meters operate on the induction principle. The torque that rotates the disk is proportional to the product of voltage, current and power factor of the circuit, and is counterbalanced by a retarding force exactly proportional to the speed. The speed of rotation is, therefore, proportional to the power in the circuit.

#### Distinctive Features

**Mechanical**—One-piece cast-iron base; all parts mounted on central cast-iron frame; perfect dust-proofing; covers easily removed and sealed; ball-bearing moving element; two permanent magnets clamped together as a unit; low-speed worm.

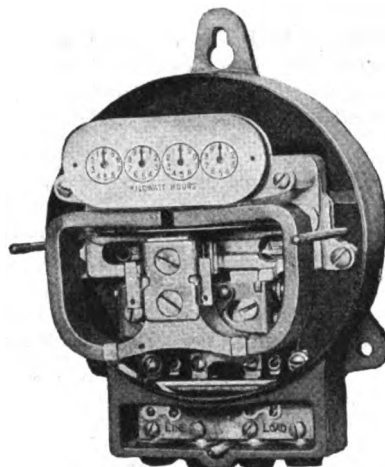
**Electrical**—High ratio of torque to weight of moving element, insuring long-life accuracy; accurate within close limits over a wide range; accurate on varying voltage; accurate on varying frequency; not affected by wave form, power factor, or external fields; permanent magnets shielded from electromagnets; low shunt loss.

**Arrangement**—Four-index dial arranged in straight line; micrometer full-load adjustment; both light and full load adjustments accessible from front of meter and only a screwdriver required; meter cover need not be removed at installation; shunt field connections made in terminal chamber.

*For Switchboard-type watt-hour meters see section 3-B, "Instruments and Relays"*

#### Construction

All parts of the meter element are mounted on a supporting casting and can be removed from the case as a unit without changing the calibration. The moving element is of the disk type, acted on by the electromagnets at one edge and the permanent magnets at the opposite edge. The electromagnet punchings are in one piece, and shifting of one part



SINGLE-PHASE METER  
(Cover Removed)

with reference to another is thus obviated. They form a closed magnetic circuit, a feature that makes the meter remarkably free from the effects of stray fields.

**Case and Cover**—The case is of cast iron and the covers of pressed zinc with dead black finish, or of glass. The cover is fitted with a dust-proof gasket and the glass windows are sealed. These precau-

## A-C. WATTHOUR METERS, TYPE OA—Continued

tions absolutely prevent the entrance of dust, which would in time cause friction errors.

**Terminal Chamber**—A separately sealed terminal chamber is provided, separated by a dust-proof partition from the meter chamber. The main cover does not have to be removed at installation, and no dust can enter the meter in making the connection. Leads enter at the bottom in the single-phase meters, and at the sides in the polyphase.

**Register**—The registering mechanism is designed for minimum friction. The sub-gear train is provided with jewel-step-bearings.

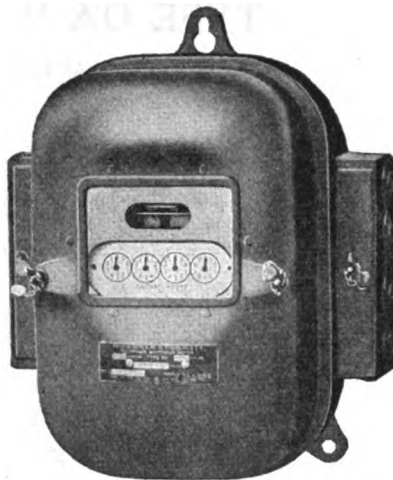
**Ratchet Attachment**—A ratchet attachment to prevent backward registration will be furnished for a net additional price of \$1.00 if ordered with meter.

**Bearings**—The main (lower) bearing is a highly polished and hardened steel ball resting between two sapphire cup jewels. The minute gyrations of the shaft give the ball a rolling action which makes a very low coefficient of friction and, by presenting constantly new bearing surface, gives an extremely long life. The upper bearing is a self-oiling guide bearing.

**Torque and Weight**—The ratio of torque to weight in type OA meters is very high, insuring a long life and freedom from friction errors for long periods. A higher torque or lower weight of disk would require permanent magnets of greater strength than long experience has indicated as practicable without danger of weakening.

**Connections**—Both line and load sides of the circuit are brought into the terminal chamber, and the shunt connection is in this chamber. Left-hand feed is standard.

**Adjustments**—The ends of the permanent magnet support slide in machined grooves and are each clamped by two screws. This prevents deflecting the magnets in tightening the clamping screws after making micrometer full-load adjustment. A micrometer light-load adjustment, absolutely independent of current, is provided. The only tool required to make adjustments is a screwdriver.



POLYPHASE METER

**Three-wire, single-phase, meters** are identical in appearance with the two-wire. The rated current is that in each outside wire.

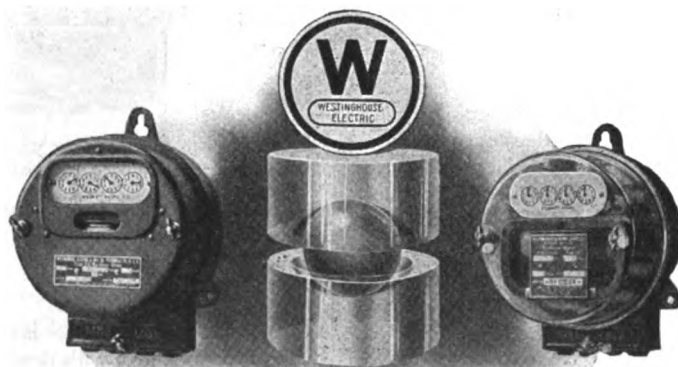
**Polyphase Meters**—Polyphase type OA meters are based on the same mechanical and electrical principles that have made the single-phase meters so successful. Each meter is in reality two single-phase meter elements supported on one mounting frame, both moving elements being mounted on a common shaft and driving a common register.

When properly connected, these meters indicate the true power in a two-phase three-wire or four-wire, or a three-phase three-wire circuit, regardless of the power factor or the degree of unbalance between phases.

**Capacity**—The rated current capacity of the polyphase meter is that in each wire of the circuit; the rated voltage is that across each phase.

## Approximate Dimensions (Inches) and Weights

	Width	Height	Depth	WEIGHT	
				Net	Boxed
Single-Phase Meters	6½	8¾	6¼	9½	11
Polyphase Meters	10	12	5¼	29	36



The Reputation of Westinghouse Watthour Meters for Sustained Accuracy Rests upon the Ball-Bearing

A-C. WATTHOUR METERS, TYPE OA—Continued

SINGLE-PHASE SELF-CONTAINED METERS

Left-Hand Feed

Style number and list price include meter complete with metal or glass cover as listed, ready for installation.

Volts	CAPACITY		25-CYCLE STYLE Nos.		40-CYCLE STYLE Nos.		60-CYCLE STYLE Nos.		List Price
	Amps.	Kw.	Metal Cover	Glass Cover	Metal Cover	Glass Cover	Metal Cover	Glass Cover	
<b>Two-Wire</b>									
100	5	.5	183728	183763	170780	170790	161363	161373	\$10 90
100	10	1	183729	183764	170781	170791	161364	161374	12 76
100	15	1.5	183730	183765	170782	170792	170818	170824	14 40
100	25	2.5	183732	183767	170784	170794	170820	170826	17 40
100	50	5	227216	227225	224789	224793	224817	224851	23 80
100	75	7.5	227217	227226	224770	224794	224818	224852	27 50
100	100	10	183736	183771	224771	224795	224819	224853	30 16
100	150	15	227218	227227	224772	224796	224820	224854	32 50
100	200	20	183738	183773	224773	224797	224821	224855	33 50
100	300	30	183739	183774	224774	224798	224822	224856	34 20
200	5	1	183740	183775	195521	195549	195570	195582	12 25
200	10	2	183741	183776	195522	195550	195571	195583	14 05
200	15	3	183742	183777	195523	195551	195572	195584	15 75
200	25	5	183744	183779	195525	195553	195574	195586	19 10
200	50	10	227219	227228	224775	224799	224823	224857	25 80
200	75	15	227220	227229	224776	224800	224824	224858	29 50
200	100	20	183748	183783	224777	224801	224825	224859	32 15
200	150	30	227221	227230	224778	224802	224826	224860	34 85
200	200	40	183750	183785	224779	224803	224827	224861	36 20
200	300	60	183751	183786	224780	224804	224828	224862	36 90
400	5	2	195391	195403	195415	195427	195463	195475	13 85
400	10	4	195392	195404	195416	195428	195464	195476	15 75
400	15	6	195393	195405	195417	195429	195465	195477	17 50
400	25	10	195395	195407	195419	195431	195467	195479	21 15
400	50	20	227222	227231	224781	224805	224829	224863	25 80
400	75	30	227223	227232	224782	224806	224830	224864	31 00
400	100	40	195399	195411	224783	224807	224831	224865	34 60
400	150	60	227224	227233	224784	224808	224832	224866	37 75
400	200	80	195401	195413	224785	224809	224833	224867	39 70
400	300	120	195402	195414	224786	224810	224834	224868	40 40

500-volt 60-cycle meters can be supplied on special order at the same price as 400-volt meters of the same ampere capacity.

Three-Wire

100-200	5	1	183752	183787	170785	170795	161367	161377	12 25
100-200	10	2	183753	183788	170786	170796	161368	161378	14 05
100-200	15	3	183754	183789	170787	170797	170821	170827	15 75
100-200	25	5	183756	183791	170789	170799	170823	170829	19 10
100-200	50	10	227234	227236	224789	224813	224847	224881	25 80
100-200	75	15	227235	227237	224790	224814	224848	224882	29 50
100-200	100	20	183780	183795	224791	224815	224849	224883	32 15
100-200	150	30	183782	183797	224792	224816	224850	224884	34 85

133-cycle meters can be supplied on special order at same price as 60-cycle meters.

SINGLE-PHASE METERS FOR USE WITH TRANSFORMERS

Left-Hand Feed

These meters are arranged for use with current transformers with 5-ampere secondaries, for current capacities higher than those listed in the preceding table. The 100-volt meters listed below can be used with voltage transformers with 100-volt secondaries for voltages higher than those listed.

Style number and list price include 5-ampere meter of the voltage listed, for use with transformers, but do not include transformers. When a meter is desired with register reading directly in kilowatt-

hours in the primary circuit, it should be ordered as: "Meter similar to Style No. (give Style No. of 100-volt meter from the following table), except with register for..... /5-ampere and..... /100-volt transformer;" or "Meter similar to Style No. (give Style No. of 200 or 400-volt meter from the following table), except with register for..... /5-ampere transformer." Price for the meter with register as ordered will be the same as for meter listed. Transformers should be added at regular prices.

Two-Wire

Volts	CAPACITY		25-CYCLE STYLE Nos.		40-CYCLE STYLE Nos.		60-CYCLE STYLE Nos.		List Price
	Amps.	Kw.	Metal Cover	Glass Cover	Metal Cover	Glass Cover	Metal Cover	Glass Cover	
100	5	.5	183954	183957	195533	195561	183960	183963	\$13 90
200	5	1	183955	183958	195534	195562	183961	183964	15 25
400	5	2	.....	.....	224787	224811	224845	224879	16 85

Three-Wire

100-200	5	1	183956	183959	195541	195569	183962	183965	15 25
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133-cycle meters can be supplied on special order at same price as 60-cycle meters.

Order by Style Number

A-C. WATTHOUR METERS, TYPE OA—Continued

POLYPHASE SELF-CONTAINED METERS

Left-hand Feed

The style number and list price include self-contained meter only, which does not require either voltage or current transformers. Meters as listed are for two-phase or three-phase, three-wire circuits and have metal covers.

Current Per Wire Amp.	Kw.	25-Cycle	STYLE No. 40 Cycle	60-Cycle	List Price	Current Per Wire Amp.	Kw.	25-Cycle	STYLE No. 40-Cycle	60-Cycle	List Price
<b>100 Volts</b>						<b>200 Volts</b>					
5	1	230486	224296	224329	\$34 40	5	2	230496	224306	224339	\$38 80
10	2	230487	224297	224330	37 05	10	4	230497	224307	224340	41 45
15	3	230488	224298	224331	39 25	15	6	230498	224308	224341	43 65
25	5	230489	224299	224332	42 35	25	10	230499	224309	224342	46 75
50	10	230490	224300	224333	48 50	50	20	230500	224310	224343	52 90
75	15	230491	224301	224334	52 90	75	30	230501	224311	224344	57 30
100	20	230492	224302	224335	56 10	100	40	230502	224312	224345	60 60
150	30	230493	224303	224336	60 00	150	60	230503	224313	224346	64 40
200	40	230494	224304	224337	63 50	200	80	230504	224314	224347	67 90
300	60	230495	224305	224338	70 55	300	120	230505	224315	224348	74 95
<b>400 Volts</b>						<b>500 Volts</b>					
5	4	230506	224316	224349	46 75	5	5	.....	.....	224359	46 75
10	8	230507	224317	224350	49 40	10	10	.....	.....	224360	49 40
15	12	230508	224318	224351	51 60	15	15	.....	.....	224361	51 60
25	20	230509	224319	224352	54 70	25	25	.....	.....	224362	54 70
50	40	230510	224320	224353	60 85	50	50	.....	.....	224363	60 85
75	60	230511	224321	224354	65 25	75	75	.....	.....	224364	65 25
100	80	230512	224322	224355	68 45	100	100	.....	.....	224365	68 45
150	120	230513	224323	224356	72 35	150	150	.....	.....	224366	72 35
200	160	230514	224324	224357	75 85	200	200	.....	.....	224367	75 85
300	240	230515	224325	224358	82 90	300	300	.....	.....	224368	82 90

133-cycle meters can be supplied on special order at same price as 60-cycle meters.

Glass Covers will be supplied on meters instead of metal covers without extra charge. Order "similar to Style No. .... except to have glass cover."

Meters for three-phase, four-wire circuits can be furnished self-contained in capacities of five to twenty-five amperes inclusive, above which size it is necessary to use a transformer type of meter with three current transformers. In either case specify in the order that the meter is for a three-phase four-wire circuit, giving current capacity, frequency, and

voltage between neutral and each phase and across phases.

Prices for self-contained three-phase four-wire watt-hour meters for 100 volts "Y" connected will be the same as for standard listed 200-volt meters of corresponding current capacity, and for 200 volts "Y" connected, prices will be the same as for 400-volt standard listed meters of corresponding current capacity. Prices for transformer type three-phase four-wire watt-hour meters will be the same as for standard listed transformer type meters.

POLYPHASE METERS FOR USE WITH TRANSFORMERS

These meters are arranged for use with current transformers with 5-ampere secondaries, for current capacities higher than those listed in the preceding table. The 100-volt meters listed below can be used with voltage transformers with 100-volt secondaries for voltages higher than those listed.

Style number and list price include 5-ampere meter of the voltage listed, for use with transformers, but do not include transformers. When a meter is desired with register reading directly in kilowatt-

hours in the primary circuit, it should be ordered as: "Meter similar to Style No. (give Style No. of 100-volt meter from the following table), except with register for...../5-ampere and...../100-volt transformer;" or "Meter similar to Style No. (give Style No. of 200, 400 or 500-volt meter from the following table), except with register for..... /5-ampere transformer." Price for the meter with register as ordered will be the same as for meter listed. Transformers should be added at regular prices.

Volts	Amps.	Kw.	25-Cycle	STYLE No. 40-Cycle	60-Cycle	List Price
100	5	1	230516	224326	224369	\$34 40
200	5	2	230517	224327	224370	38 80
400	5	4	230518	224328	224371	46 75
500	5	5	.....	.....	224372	46 75

133-cycle meters can be supplied on special order at same price as 60-cycle meters.

Order by Style Number



## TYPE OA PREPAYMENT ATTACHMENTS

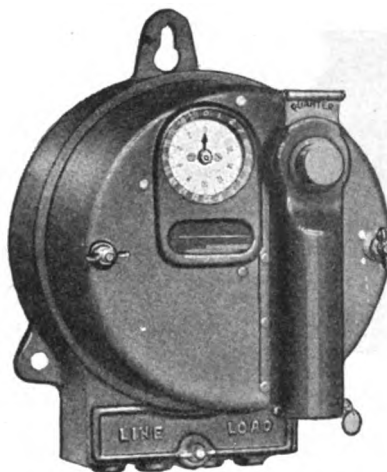


FIG. 1—TYPE OA WATTHOUR METER WITH PREPAYMENT ATTACHMENT

**Application**—The type OA watthour meter equipped with the type OA prepayment attachment (Fig. 1) is especially useful when supplying current to small consumers, since at small additional first cost it collects the bill and saves bookkeeping. It is also useful when supplying a shifting population such as at Summer Resorts, for it saves following up the consumer to collect the bill. It also decreases the stock of meters and parts required by operating companies to effect such installations. By means of the attachment a standard OA single-phase watthour meter can be converted into a prepayment meter, or when it is no longer desired as a prepayment meter, it can be changed back to a standard watthour meter by replacing the standard register and cover.

**Operation**—The prepayment attachment mechanism is entirely mechanical. By placing a quarter in the top of the coin chamber and by turning the knob in the direction of the arrow the meter is made ready to give electrical service as required by the consumer. This operation of the knob winds a clock spring which is unwound by gears at a speed depending upon the rate per kilowatt hour for which the attachment is furnished. When the spring is completely unwound a quick-break switch is automatically opened and the customer is without power until additional quarters have been placed in the coin mechanism. The attachment can be supplied for rates of 4 to 25 cents per kilowatt hour (full cents only). **Specify rate desired in your order.**

The attachment is designed to receive quarters in any number up to sixteen at one time, provided that

the customer has no quarters already to his credit. A pointer always indicates on a marked dial the number of quarters that remain to the credit of the customer. When the customer has sixteen coins to his credit, the sixteenth coin automatically closes the coin chamber so that no more coins can be placed in the mechanism until electrical energy equal to the value of one or more quarters has been used. The coin chamber will hold approximately twenty-five quarters.

With the aid of the scale marked on the cover (see Fig. 1) and surrounding the indicating dial

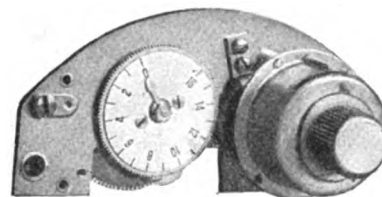


FIG. 2—TYPE OA PREPAYMENT ATTACHMENT WITHOUT INTEGRATING DIALS

it is possible to determine the number of quarters that have been placed in the meter, by observing the position of the zero on the dial with reference to the numbers on the fixed scale on the cover. Knowing the number of quarters and the rate per kilowatt hour, the number of kilowatt hours can be determined. If it is not desirable to determine in this manner the kilowatt hours used by the consumer, the attachment can be supplied with a small three-dial register reading direct in kilowatt hours. This register is shown in Fig. 4.

TYPE OA PREPAYMENT ATTACHMENTS—Continued

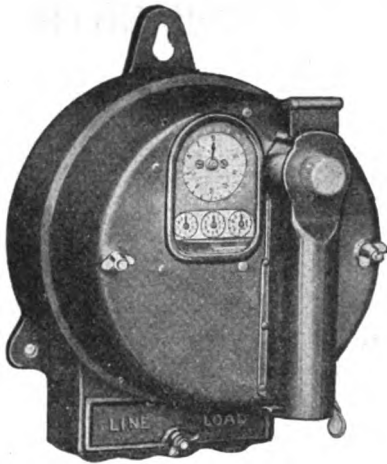


FIG. 3—TYPE OA WATTHOUR METER WITH PREPAYMENT ATTACHMENT AND WITH INTEGRATING DIALS

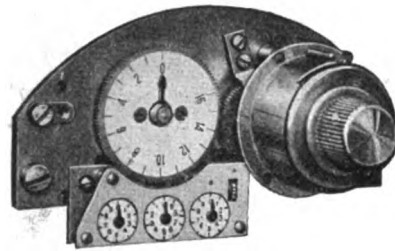


FIG. 4—TYPE OA PREPAYMENT ATTACHMENT WITH INTEGRATING DIALS

TYPE OA SINGLE-PHASE WATTHOUR METERS

With Prepayment Attachment\* and Cover

TWO-WIRE

Style number and list price include type OA single-phase watthour meter complete with prepayment attachment and cover.

Without Integrating Dials

Amperes	Volts	Kw.	25 CYCLES		60 CYCLES	
			Style No.	List Price	Style No.	List Price
5	100	.5	293309	\$21 00	293311	\$20 00
10	100	1.0	293313	23 00	293315	22 00
5	200	1.0	293317	22 00	293319	21 00
10	200	2.0	293321	24 00	293323	23 00

With Integrating Dials

Amperes	Volts	Kw.	25 CYCLES		60 CYCLES	
			Style No.	List Price	Style No.	List Price
5	100	.5	293310	\$23 00	293312	\$22 00
10	100	1.0	293314	25 00	293316	24 00
5	200	1.0	293318	24 00	293320	23 00
10	200	2.0	293322	26 00	293324	25 00

PREPAYMENT ATTACHMENT\* AND COVER

TWO-WIRE

Style number and list price include prepayment attachment and cover only for type OA single-phase watthour meters.

METER		Prepayment Attachment Kw.	Without Integrating Dials		With Integrating Dials	
Amperes	Volts		Style No.	List Price	Style No.	List Price
5	100	.5	293303	\$11 00	293304	\$12 00
10	100	1.0	293305	11 00	293306	12 00
5	200	1.0	293305	11 00	293306	12 00
10	200	2.0	293307	11 00	293308	12 00

\*Prepayment attachments can be supplied for the following rates: 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 18, 20, and 25 cents per kilowatt hour. When ordering specify rate desired.

Order by Style Number

## TYPE OA DEMAND ATTACHMENT



TYPE OA POLYPHASE WATTHOUR METER WITH DEMAND ATTACHMENT

### Application

The Westinghouse type OA demand attachment is a watthour meter register which combines the regular watthour meter register with the scale and pointers of an indicating demand meter. By replacing the register and the cover of a standard polyphase OA watthour meter with this new attachment and a special cover, the type OA watthour meter is converted into an indicating, block-interval demand meter. After this change has been made, the meter will indicate the maximum kilowatt demand and the integrated kilowatt hours.

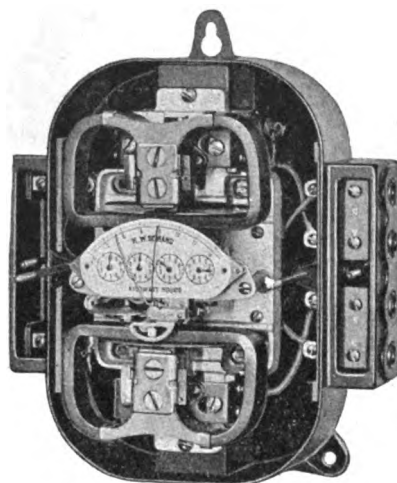
The demand attachment can be used to measure demand wherever the indicating type of demand meter is satisfactory. Smaller power installations, where investment does not permit the use of the more expensive recording demand meter, offer the most frequent applications.

### Distinctive Features

- Block-interval demand.
- Induction motor with excellent performance characteristics. High torque, constant speed with varying voltage and temperature.
- Positive action of trip.
- Negligible time lapse between successive time-intervals.
- Two demand pointers.
- Demand attachment and cover interchangeable with register and cover of standard type OA polyphase watthour meter.
- Rugged construction.

### Operation and Construction

The attachment operates on the block-interval principle similar to the Westinghouse type RA watthour demand meter. In the attachment, the demand-scale, two pointers, and a small induction motor for time keeping are analogous to the chart, pen and 35-day clock of the type RA demand meter.



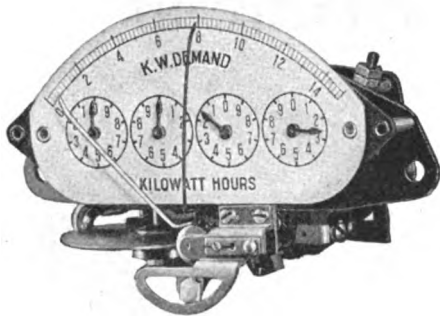
TYPE OA POLYPHASE WATTHOUR METER WITH DEMAND ATTACHMENT—COVER REMOVED

As in the type RA watthour demand meter, the attachment is designed to give an integrated block-interval demand indicator with a negligible lapse of time between the measurement of adjacent blocks. This short interval of approximately two seconds is arranged for by disengaging the gears that advance the demand pointer from the gear train of the watthour meter and is ample time to allow the pointer to return to zero from full scale deflection. The demand attachment has two pointers; one finished in white and the other in black.

The white pointer advances the maximum demand pointer (black pointer) to any maximum demand position on the demand scale. Here the black pointer is held by friction, while the white one returns to zero at the end of each time-interval. If the movement of the white pointer is noted, the duration of the demand interval can be checked as well as the demand at the time of reading the meter. The white pointer shows an integrated demand and not an instantaneous demand.

Gravity returns the white pointer to zero after the gears driving the pointer have been disengaged from the gear train of the watthour meter. The time at which the gears are disengaged, hence, the time interval of the attachment, is determined by the small induction motor. Although this motor is spoken of as small, it gives many times the torque necessary to release the white pointer at the end of the time interval, thus assuring positive action of the attachment. With constant frequency, the motor has practically a constant speed over a voltage range varying from 90 to 110 per cent of rated voltage. This fact allows the calibration of a meter in the laboratory and the installation of it on a line which has a voltage variation of several per cent from the calibration voltage, and yet no appreciable error is introduced into the length of time interval of the demand meter.

TYPE OA DEMAND ATTACHMENT—Continued



DEMAND ATTACHMENT

The 3¼-inch scale of the demand attachment is comparatively long considering the available space. Full scale deflection of the demand pointer is approximately 100 degrees.

The demand scale is marked directly in kilowatts demand, but the watthour recording dials are used with the register constant of 10 or multiples of 10 where necessary, similar to the practice followed with the standard type OA watthour meter register.

When ordering demand attachments or complete meters with attachment for Two-phase or Three-phase Four-wire circuits select one of the following styles and have order read "Similar to Style..... except for two-phase (or three-phase four-wire) circuits."

To facilitate in checking the motor speed, there is a small pointer which will make 4 rpm. if the motor is running at the proper speed of 200 rpm.

TYPE OA DEMAND ATTACHMENTS FOR POLYPHASE WATTHOUR METERS

Style Number and List Price Include Demand Attachment and Cover Only

Volts	Amps.	Kw.	Cycles	METAL COVER		List Price	GLASS COVER		List Price
				15-Minute Interval	30-Minute Interval		15-Minute Interval	30-Minute Interval	
100	5	1	25	328742	328748	\$20 00	328754	328760	\$20 00
100	10	2	25	328743	328749	20 00	328755	328761	20 00
100	15	3	25	328744	328750	20 00	328756	328762	20 00
100	25	5	25	328745	328751	20 00	328757	328763	20 00
100	50	10	25	328746	328752	20 00	328758	328764	20 00
100	75	15	25	328747	328753	20 00	328759	328765	20 00
100	5	1	60	328766	328772	20 00	328776	328782	20 00
100	10	2	60	328767	328773	20 00	328777	328783	20 00
100	15	3	60	328768	328774	20 00	328778	328784	20 00
100	25	5	60	328769	328775	20 00	328779	328785	20 00
100	50	10	60	328770	328776	20 00	328780	328786	20 00
100	75	15	60	328771	328777	20 00	328781	328787	20 00
200	5	2	60	328790	328796	20 00	328782	328788	20 00
200	10	4	60	328791	328797	20 00	328783	328789	20 00
200	15	6	60	328792	328798	20 00	328784	328790	20 00
200	25	10	60	328793	328799	20 00	328785	328791	20 00
200	50	20	60	328794	328800	20 00	328786	328792	20 00
200	75	30	60	328795	328801	20 00	328787	328793	20 00
200	5	2	25	356572	356592	25 00	356620	356632	25 00
200	10	4	25	356573	356597	25 00	356621	356633	25 00
200	15	6	25	356574	356598	25 00	356622	356634	25 00
200	25	10	25	356575	356599	25 00	356623	356635	25 00
200	50	20	25	356576	356600	25 00	356624	356636	25 00
200	75	30	25	356577	356601	25 00	356625	356637	25 00
400	5	4	60	356582	356606	25 00	356626	356638	25 00
400	10	8	60	356583	356607	25 00	356627	356639	25 00
400	15	12	60	356584	356608	25 00	356628	356640	25 00
400	25	20	60	356585	356609	25 00	356629	356641	25 00
400	50	40	60	356586	356610	25 00	356630	356642	25 00
400	75	60	60	356587	356611	25 00	356631	356643	25 00

TYPE OA DEMAND ATTACHMENTS FOR USE WITH POLYPHASE TRANSFORMER-TYPE METERS

Wherever it is desired to use an attachment on a transformer-type meter and the kilowatt capacity of the desired attachment differs from any of the above listed styles, order one of the following styles, giving

rating of the meter on which the attachment is to be used as well as the ratios of the current and voltage transformers.

†100	5	..	25	328814	328815	\$20 00	328816	328817	\$20 00
†100	5	..	60	328818	328819	20 00	328820	328821	20 00
†200	5	..	60	328822	328823	20 00	328824	328825	20 00
*100	5	1	25	328826	328827	20 00	328828	328829	20 00
*100	5	1	60	328830	328831	20 00	328832	328833	20 00
200	1	5	25	356644	356645	25 00	356646	356647	25 00
200	1	5	25	356648	356649	25 00	356650	356651	25 00
400	2	5	60	356648	356649	25 00	356650	356651	25 00
400	4	5	60	356602	356603	25 00	356604	356605	25 00

\*This attachment has a one kilowatt demand scale and watthour meter register for use with any combination of current and voltage transformers. The words "multiply by" are printed below both the demand scale and the watthour dials so that a constant depending upon the product of the ratios of the current and voltage transformers may be inserted. Do not order these styles if it is desired to have the demand scale direct reading.

†When ordering, give ratios of current and voltage transformers.

TYPE OA DEMAND ATTACHMENT—Continued

TYPE OA POLYPHASE WATTHOUR METERS COMPLETE WITH DEMAND ATTACHMENTS AND COVERS

Style Number and List Price Include Type OA Polyphase Watthour Meter Complete With Demand Attachment and Cover

Volts	Ampa.	Kw.	Cycles	METAL COVER		List Price	GLASS COVER		List Price
				15-Minute Interval	30-Minute Interval		15-Minute Interval	30-Minute Interval	
100	5	1	25	328650	328656	54 50	328662	328668	54 50
100	10	2	25	328651	328657	57 00	328663	328669	57 00
100	15	3	25	328652	328658	59 50	328664	328670	59 50
100	25	5	25	328653	328659	62 50	328665	328671	62 50
100	50	10	25	328654	328660	68 50	328666	328672	68 50
100	75	15	25	328655	328661	73 00	328667	328673	73 00
100	5	1	60	328674	328680	54 00	328686	328692	54 50
100	10	2	60	328675	328681	57 00	328687	328693	57 00
100	15	3	60	328676	328682	59 50	328688	328694	59 50
100	25	5	60	328677	328683	62 50	328689	328695	62 50
100	50	10	60	328678	328684	68 50	328690	328696	68 50
100	75	15	60	328679	328685	73 00	328691	328697	73 00
200	5	2	60	328698	328704	59 00	328710	328716	59 00
200	10	4	60	328699	328705	61 50	328711	328717	61 50
200	15	6	60	328700	328706	63 50	328712	328718	63 50
200	25	10	60	328701	328707	67 00	328713	328719	67 00
200	50	20	60	328702	328708	73 00	328714	328720	73 00
200	75	30	60	328703	328709	77 50	328715	328721	77 50
200	5	2	25	356492	356516	64 00	356540	356552	64 00
200	10	4	25	356493	356517	66 50	356541	356553	66 50
200	15	6	25	356494	356518	68 50	356542	356554	68 50
200	25	10	25	356495	356519	72 00	356543	356555	72 00
200	50	20	25	356496	356520	78 00	356544	356556	78 00
200	75	30	25	356497	356521	82 50	356545	356557	82 50
400	5	4	60	356502	356526	72 00	356546	356558	72 00
400	10	8	60	356503	356527	74 50	356547	356559	74 50
400	15	12	60	356504	356528	76 50	356548	356560	76 50
400	25	20	60	356505	356529	80 00	356549	356561	80 00
400	50	40	60	356506	356530	86 00	356550	356562	86 00
400	75	60	60	356507	356531	90 00	356551	356563	90 00

TYPE OA POLYPHASE WATTHOUR METERS TRANSFORMER-TYPE COMPLETE WITH DEMAND ATTACHMENTS AND COVERS

†100	5	..	25	328722	328723	54 50	328724	328725	54 50
200	5	..	25	356564	356565	64 00	356566	356567	64 00
†100	5	..	60	328726	328727	54 50	328728	328729	54 50
†200	5	..	60	328730	328731	59 00	328732	328733	59 00
400	5	..	60	356568	356569	72 00	356570	356571	72 00
*100	5	1	25	328734	328735	54 50	328736	328737	54 50
200	5	2	25	328582	328584	64 00	328586	328588	64 00
*100	5	1	60	328738	328739	54 50	328740	328741	54 50
400	5	4	60	328590	328591	72 00	328592	328593	72 00

\*This attachment has a one kilowatt demand scale and watthour meter register for use with any combination of current and voltage transformers. The words "Multiply by" are printed below both the demand scale and the watthour dials so that a constant depending upon the product of the ratios of the current and voltage transformers may be inserted. Do not order these styles if it is desired to have the demand scale direct reading.

†Attachments of certain other capacities and intervals can be obtained on special order.

‡When ordering, give ratios of current and voltage transformers.

Order by Style Number

## TYPE RA RECORDING-DEMAND WATTHOUR METERS POLYPHASE

### Application

The type RA recording-demand watthour meter in one unit measures both the kilowatt-hours consumed and the integrated demand. It indicates on a four-counter dial the total kilowatt-hours consumed and records in a permanent form the integrated demand over successive predetermined time intervals.

Because of its simplicity and exceptional reliability, it is especially applicable for determining the demand of power installations, particularly where a permanent record of the demand, involving the time and length of occurrence, is wanted.

By using meters with synchronous-motor clocks two or more meters may be kept in exact synchronism and simultaneous demands at various points of a system may be recorded.

**Capacity**—The rated current capacity is that in each wire of the circuit; the rated voltage is that across each phase. The indicating mechanism is

arranged so that full scale deflection is 50 per cent overload on the meter.

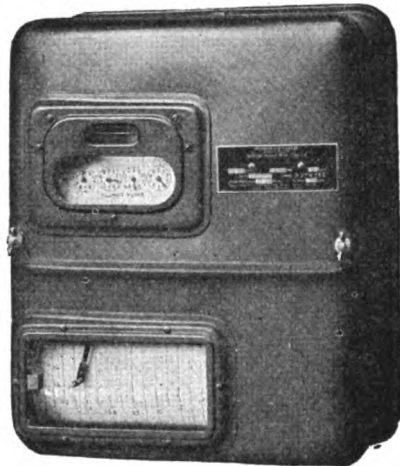


FIG. 1

### DISTINCTIVE FEATURES

1. The type RA is a recording-demand watthour meter, is entirely self-contained and is installed as an ordinary watthour meter and requires no additional apparatus or wiring.
2. It is mounted on a one-piece cast iron base with cover that makes the meter thoroughly dust-proof. The cover can be easily removed and is as easily sealed.
3. The measuring and recording elements are mechanically interconnected; there are no electrical contacts to become inoperative.

4. This meter can be supplied with either a hand-wound 35-day clock or a synchronous-motor clock.
5. The record paper is of sufficient length to last thirty-six days, and the self-inking feature provides sufficient ink for 35 days, thus reducing the maintenance cost.
6. The measuring element is the standard Westinghouse type OA watthour meter with special gear train.

### OPERATION

The type RA recording-demand watthour meter consists of a watthour meter with the usual four-counter register and, in addition, the mechanism for obtaining a graphic record of the demand. The time interval of the meter and the advance of the

record paper are controlled by a hand-wound clock mechanism.

**Principle of Operation**—Under load, the gear train of the watthour meter advances the counters in the regular manner. At the same time the gear train causes the ink-carrying pen to advance across the record paper in proportion to the energy registered. At the end of a predetermined time interval a stud on the reset wheel releases the pen gear from mesh with the gear train and a balancing weight returns the pen to zero where it is again meshed with the gear train to repeat its advance during the next time interval.

Just before the pen gear is released, the record paper is advanced a sixteenth inch by the operating spring so that the pen makes a distinct and readily observed record of the maximum pen travel showing both the amount of integrated demand and, by the time calibration printed on the record paper, the time of its occurrence.

**Time Interval**—The reset wheel, which makes one complete revolution per hour, is arranged for the

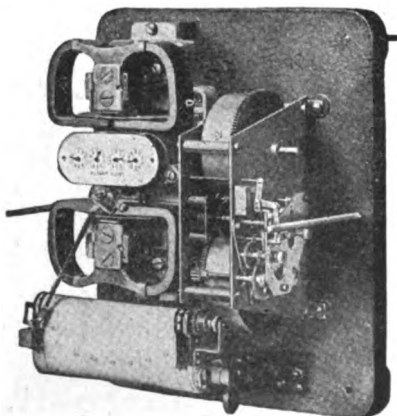


FIG. 2

## TYPE RA RECORDING-DEMAND WATTHOUR METERS—Continued

insertion of four studs. When all four studs are used, the meter has a 15-minute time interval on the integrated demand. With two studs in place, arranged 180 degrees apart, the meter has a 30-minute time interval; and with only one stud, a 60-minute time interval. However, each time interval requires its particular gear train for obtaining the proper full-scale record at rated voltage. It is therefore necessary to change the gear train if the time interval is desired changed; this change can be made at installation. Additional gear trains are listed for making this change.

The operating spring causes the paper to advance one-sixteenth inch every 15 minutes. Thus, if the reset wheel is equipped with studs for a 15-minute time interval, the paper is advanced just before the pen is reset (see Fig. 3). If, however, the reset wheel is set for thirty-minute intervals, the paper will advance one 15-minute space between reset periods, causing an offset mark on the chart at

the middle of the 30-minute period (see Fig. 4). This offset mark enables the reading of the integrated demand at 15-minute intervals as well as 30-minute. Similarly, if the reset wheel is set for one-hour intervals, three offset marks give indications from which the 15- or 30-minute demands during the one-hour interval may be obtained.

**Polyphase Meters**—The standard type RA meters are all polyphase having virtually two independent single-phase electrical elements enclosed in the same case, with the watthour register and the demand recording devices in common. As with the polyphase type OA watthour meter, the two torque elements are on the same shaft so that, each exerting its torque on the shaft, the total rotative torque is proportional to the total power in the metered phases. The meter, therefore, when properly connected, records the true power in a two-phase 3 or 4-wire or a three-phase 3-wire circuit, regardless of power factor or the degree of unbalance between phases.

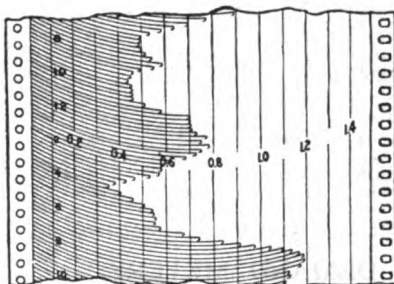


Fig. 3—Made by a 15-Minute-Interval Meter

FAC-SMILE OF RECORD CHART MADE BY TYPE RA RECORDING-DEMAND WATTHOUR METER

Note that on the chart of Fig. 4 the 15-minute as well as the 30-minute demand is shown.

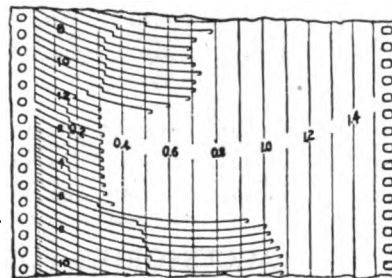


Fig. 4—Made by a 30-Minute-Interval Meter

## CONSTRUCTION

The entire meter is mounted on a cast iron base. The cover is of pressed zinc with dead black finish. It is fitted with a dust-proof gasket and the glass windows over the dial and chart are well sealed.

**Measuring Element**—The electrical measuring element consists of the standard type OA watthour meter on its own supporting casting but without cover. Therefore this element can be removed from the case as a unit without changing the calibration.

**Clock**—A high-grade clock of the latest type and having a balance wheel type escapement is used. In order that the drive may be at all times positive and constant even though the heavy main spring is nearly unwound, a small helical intermediate spring is interposed. The main spring serves to keep this intermediate spring wound, while the intermediate spring drives the clock escapement with constant torque. An additional heavy operating spring provides power for the advancing of the paper chart and the pen arm reset thus relieving the main spring of this duty and resulting in improved time keeping of the clock.

The synchronous-motor clock is provided with a small, slow-speed, high-torque synchronous motor

used for timing only. The function of the motor is to release the hand-wound spring which drives the chart. This method of controlling the recording element places no load on the synchronous-motor thereby assuring high accuracy and long life for the motor.

**The paper driving mechanism** is a metal drum with pins that engage in perforations in the record paper, driven through gearing by the operating spring. The paper is held on a spindle and is wound off this onto a drum by the driving mechanism.

**The record paper** for these meters is of stock specially selected for satisfactory records and is accurately ruled, with the hours stamped on one margin. An accurate drive is assured by perforations in the paper in which pins on the driving mechanism engage. The paper is furnished in 18-foot rolls. As it is advanced one-quarter inch per hour, one roll is therefore sufficient for thirty-six days' record.

**The pen** is of the V-point type that is familiar to operators of graphic recorders. The self-inking device will hold a supply of ink sufficient to last for at least 35 days.

TYPE RA RECORDING-DEMAND WATTHOUR METERS—Continued

The ink is furnished in liquid form and is especially prepared to give satisfaction with the pen and paper supplied.

boards up to two inches thick are supplied with all meters. A terminal block is also mounted under the iron base for front connection; the studs are not used when meter is front connected.

**Terminals**—Studs for rear connection on switch-

POLYPHASE METERS FOR USE WITH TRANSFORMERS

Style number and list price include 5-ampere meter of the voltage listed, two rolls of record paper and one 2-ounce bottle of ink; but do not include transformers. When the meter is to be used with both current and voltage transformers, the 100-volt meter should be selected. (The multiplier to be used is the product of the transformer ratios).

Transformers should be added at regular prices (see catalogue on "Instruments and Relays").

Volts	Amps.	Kw.	With Hand-Wound Clocks				With Synchronous-Motor Clocks				List Price
			5-Minute Interval	15-Minute Interval	30-Minute Interval	60-Minute Interval	5-Minute Interval	15-Minute Interval	30-Minute Interval	60-Minute Interval	
<b>For 25-Cycle Circuits</b>											
100	5	1	258088	258097	258106	258115	375600	375601	375602	375603	\$140 00
100*	5	1.5	276336	276338	276340	276342	375616	375617	375618	375619	155 00
200	5	2	258089	258098	258107	258116	.....	.....	.....	.....	145 00
400	5	4	258090	258099	258108	258117	.....	.....	.....	.....	150 00
<b>For 40-Cycle Circuits</b>											
100	5	1	258091	258100	258109	258118	.....	.....	.....	.....	140 00
200	5	2	258092	258101	258110	258119	.....	.....	.....	.....	145 00
400	5	4	258093	258102	258111	258120	.....	.....	.....	.....	150 00
<b>For 60-Cycle Circuits</b>											
100	5	1	258094	258103	258112	258121	375604	375605	375606	375607	140 00
100*	5	1.5	276337	276339	276341	276343	375620	375621	375622	375623	155 00
200	5	2	258095	258104	258113	258122	375608	375609	375610	375611	145 00
400	5	4	258096	258105	258114	258123	375612	375613	375614	375615	150 00
500	5	5	364257	364258	364259	364260	.....	.....	.....	.....	155 00

†††Synchronous clocks for certain other voltages and frequencies can be supplied on special order. Prices on request.

ACCESSORIES FOR TYPE RA DEMAND METERS

Record Paper

Volts	Amps.	Kw. (full load)	STYLE NOS.		List Price Per Roll
			5-Minute Interval	15, 30 and 60-Minute Interval	
100	5	1	286931††	237204	\$0 35
200	5	2	286932††	263096	35
400	5	4	286933††	263097	35
500	5	5	375087††	357263	35
100**	5	1.5	375078††	280943	35

Gear Trains

Style number and list price include gear train and three studs for changing time interval on clock mechanism.

Volts	Amps.	Kw.	STYLE NOS.				List Price
			5-Minute Interval	15-Minute Interval	30-Minute Interval	60-Minute Interval	
100	5	1	258366	258369	258372	258375	\$10 00
200	5	2	258367	258370	258373	258376	10 00
400	5	4	258368	258371	258374	258377	10 00
100**	5	1.5	364253	364254	364255	364256	10 00

Pen and Ink

	Style Nos.	List Price
Pen and pen arm complete	276367	\$0 75
Red ink, per 2-ounce bottle	258332	35
Blue print red ink, per 2-ounce bottle	321361	35
A small resistance unit of approximately 30-watt consumption can be supplied for mounting beneath clock where it is necessary to mount meter in outdoor meter houses in cold climates.		
Resistor complete with candelabra base (state voltage rating of meter in ordering)		\$2 00

APPROXIMATE DIMENSIONS AND WEIGHTS

All Style Nos.	DIMENSIONS IN INCHES			WEIGHTS, LBS.	
	Width 10½	Height 13½	Depth 6¾	Net 30	Boxed 85

These dimensions are for reference only. For official dimensions apply to nearest District Office.  
 \*These meters are equipped with ten terminals, special gear trains, and current coils for three-phase four-wire circuits.  
 \*\*For three-phase four-wire meters only.  
 †Orders not accepted for less than ten rolls of paper or for less than four bottles of ink on one order.  
 ††Charts must be renewed every twelve days. The 5-minute chart advances ¼ inch per hour.

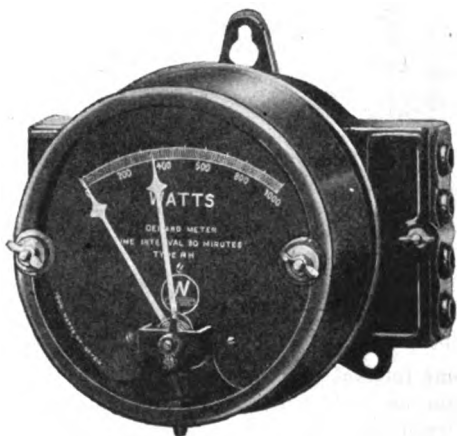
Order by Style Number



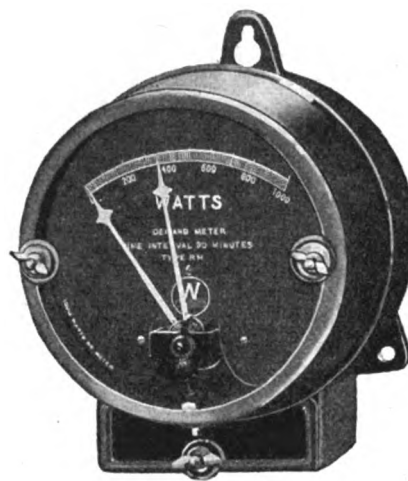
## TYPE RH THERMAL DEMAND METERS

Supplied as

Indicating and Recording Wattmeters for Single or Polyphase Alternating Currents or Indicating and Recording Ammeters for Alternating or Direct Current



POLYPHASE METER



SINGLE-PHASE METER

**Application**—The type RH thermal demand meter indicates the "logarithmic demand" of the circuit to which it is connected. It operates by heat storage from an electrical heating element with an indicating element involving a heat-sensitive bimetallic spring system.

When full load is applied, this meter registers full scale after a certain time interval, in accordance with the "logarithmic" law.

There is a maximum pointer which can be reset without opening the meter and which is carried by the moving pointer and left in the position of highest demand reached since the meter was last reset. No recording device is contained in the indicating meter so that the exact time of the maximum demand is not shown.

**Distinctive Features**—Its simplicity and its freedom from mechanical difficulties make it especially valuable on rapidly fluctuating loads.

The indicating ammeter is especially applicable in determining the average current on steel mill or other motors where the load varies through a wide range within the space of a few seconds of time.

This instrument has no clock contacts or other delicate parts.

Maintenance cost are reduced to a minimum.

The polyphase meter is only slightly larger than the single-phase meter.

**Operation**—The following is a brief description of the thermal storage wattmeter:

Referring to Fig. 1, A is a circuit feeding a load B. C is a small transformer incorporated within the meter with its primary across the circuit A. In series with the secondary of this transformer are two equal resistances, R-1 and R-2. A current is set up in these resistances that is proportional to the voltage of the circuit A. The load current is also caused to circulate through these same resistances in the manner shown in Fig. 1, being taken into the middle of the secondary of the small transformer and being taken out at the connection between resistances R-1 and R-2. These two currents—one the secondary current, due to the presence of the voltage and the other due to the passage of the load current—are additive in one of these resistances and subtractive in the other, and the difference in the heating effect of the two resultant currents is proportional to the watts of the load B.

If we represent the current that passes through the resistance R-1 and R-2, due to the presence of the voltage by E, and the load current therein by I, the resultant current in one of these resistances is E plus I, and in the other E minus I. The losses are proportional to the squares of these currents and the differences of these losses is proportional to the product EI.

F and G represent two spiral springs made from bimetallic strip, attached rigidly to their casings at the outer ends and to a common shaft H at their inner ends. These bimetallic springs tend to coil

## TYPE RH THERMAL DEMAND METERS—Continued

up on an increase in temperature (due to the difference in temperature coefficient of the two metals of which they are composed), but, since the two springs are wound in opposite directions, no movement of the shaft *H* will take place unless there is a difference in temperature between *F* and *G*. The shaft *H*, therefore, will not turn with changes in atmospheric temperature or with any other condition that causes both springs to maintain the same temperature, but will respond only to the difference in temperature caused by the difference in the losses in resistances *R-1* and *R-2*. *S-1* and *S-2* represent diagrammatically the thermal storage of the cases in which the bimetallic springs *F* and *G* are enclosed. Due to this thermal storage, the wattmeter does not respond instantly to a change in load but always indicates the logarithmic average load over the time period immediately preceding the instant of observation, the length of this time period being determined in part by the amount of thermal storage in the cases, shown diagrammatically at *S-1* and *S-2*. *K* is a pointer attached to shaft *H* and traveling over the scale *L*. *M* is a friction pointer which shows the highest position of pointer *K* since last reset.

From the above it is easily seen that the meter depends for its indication upon the effect of heaters on spiral bimetallic springs. In the wattmeter, a difference of temperature in the two springs proportional to the watts in the circuit is produced by the arrangement of the circuits. In the ammeters, only one spring is heated by the current in the circuit. This gives a scale deflection nearly proportional to the square of the current flowing.

The time element of the meter is due to the heat capacity of the boxes containing the heaters and springs. As in other thermal devices the time element for any given change of load is constant. Thus in a 30-minute interval meter as mentioned above it requires 30 minutes for the pointer to move from zero to 90 per cent of full scale with full load applied.

Assume that this meter had full load, 1000 watts, applied for 30 minutes the reading would be 900 watts and if the same load continued for another 30 minutes the reading would be 990 watts. This is in accordance with the approximate logarithmic curve.

Again, assume that this meter had half load, 500 watts, applied for a sufficient time to bring the pointer to equilibrium at half scale. Then, if full load is applied for 30 minutes the pointer will go 90 per cent of the distance from half scale to full scale and reach the 95 per cent point of it. [50 per cent + (90 per cent of 50 per cent)].

These characteristics are similar to the thermal conditions of all electrical apparatus under changes of load.

**Resetting**—A small sealable screw at the bottom of the case is turned by the aid of a screwdriver to reset the maximum pointer.

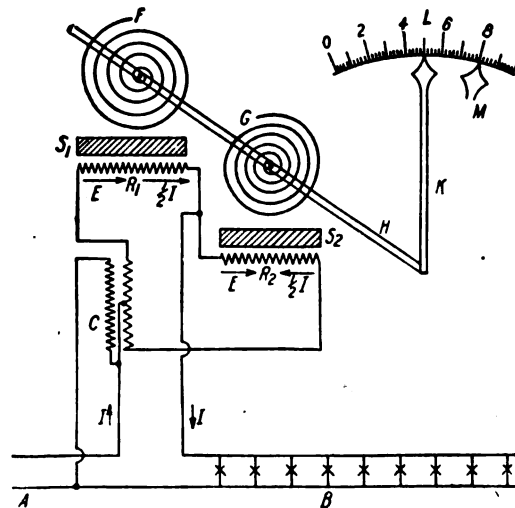


FIG. 1

**Dial Marking**—The dial is direct reading with a nearly uniform scale for the wattmeter, and with an approximate scale of squares for the ammeter.

**Time Interval**—Meters are listed for 15 and 30-minute intervals only. During this interval the pointer arrives at a place equivalent to 90 per cent on the logarithmic time curve.

**Polyphase Meters**—All meters have a double set of heating elements. One set is connected in each phase for the polyphase, while for single-phase the two sets are connected either in series or parallel.

**Construction**—All parts of the meter element are mounted on a supporting casting which allows it to be removed as a unit without affecting the calibration.

**Terminal Chamber**—Separately sealed terminal chambers are provided separated by a dust-proof partition from the meter chamber. As the main covers do not need to be removed at installation the meter seals applied in the central station's laboratory can be retained. Each terminal chamber has a cover fastened on by one wing nut.

In the single-phase meters the terminal chamber is at the bottom. In the polyphase meters, two terminal chambers are provided, one on the left-hand side of the meter for the line connections, and one on the right-hand side for the load connections, the leads entering the sides of these chambers.

**Bearings**—Reliability and ruggedness are insured by the use of high torque, plain phosphor bronze bearings.

**Adjustments**—There are two adjustments which can be made if necessary, "zero" and "full load." The former adjustment is made by turning the small screw at the front end of the shaft, while the latter is made by turning the screw at the top of the meter. To increase the meter reading turn the

TYPE RH THERMAL DEMAND METERS—Continued

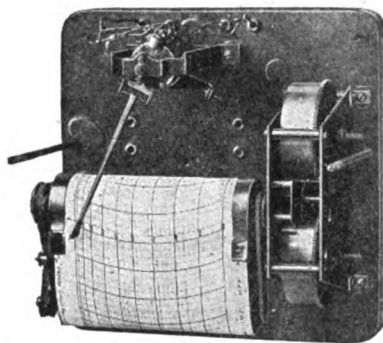
screw right-handed (down), while to decrease the reading turn the screw left-handed (up).

Three-wire single-phase meters are identical in appearance with the two-wire. The rated current is that in each outside wire.

**Meters for Use with Transformers**—For current

capacities higher than those listed in the tables, meters are arranged for use with current transformers having 5-ampere secondaries. For voltages higher than those listed, the 100-volt meters may be used with voltage transformers having 100-volt secondaries.

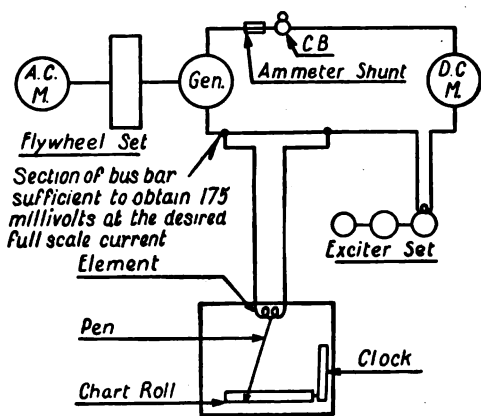
THERMAL RECORDING AMMETER



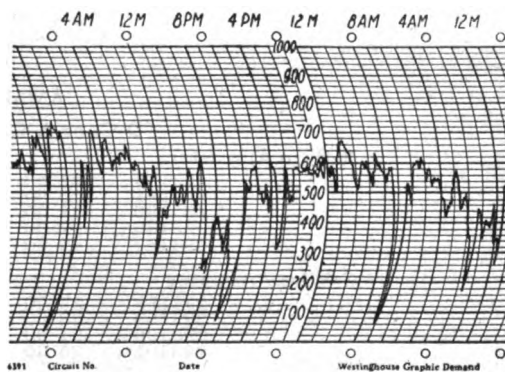
THERMAL RECORDING AMMETER—COVER REMOVED

The Thermal Recording Ammeter is particularly applicable to large rolling mill motors where the current in the circuit fluctuates so rapidly that an ordinary meter is of no use. The thermal meter responds to the heating effect of the current and gives an indication proportional to the average or "root-mean-square" current over an appreciable time period. Thus the real load on the motor can be observed and its performance compared with its guaranteed rating.

The standard thermal recording ammeter is calibrated for 1-volt drop at its terminals for full-scale deflection and requires approximately 5 amperes to operate at this voltage. By means of the external resistance, the circuit to the meter can be adjusted so that 1 volt is obtained at some even value of motor current, say 4000 or 5000 amperes or whatever value of current is desired.



SCHEMATIC DIAGRAM OF CONNECTIONS FOR THERMAL RECORDING AMMETER



TYPICAL CURVE TAKEN BY THERMAL RECORDING AMMETER ON REVERSING-MILL MOTOR CIRCUIT

TYPE RH THERMAL DEMAND METERS—Continued

TYPE RH THERMAL DEMAND METERS

SINGLE-PHASE WATTMETERS

15-Minute Time Interval  
2-Wire Wattmeters

30-Minute Time Interval  
2-Wire Wattmeters

Am-peres	Volts	Kw.	STYLE No.		List Price	Am-peres	Volts	Kw.	STYLE No.		List Price
			25-Cycle	60-Cycle					25-Cycle	60-Cycle	
5	100	0.5	293131	293126	\$25 00	5	100	0.5	293198	293193	\$25 00
10	100	1.0	293132	293127	28 00	10	100	1.0	293199	293194	28 00
15	100	1.5	293133	293128	31 00	15	100	1.5	293200	293195	31 00
25	100	2.5	293134	293129	35 00	25	100	2.5	293201	293196	35 00
50	100	5.0	293135	293130	43 00	50	100	5.0	293202	293197	43 00
5	200	1	293145	293140	28 00	5	200	1	293212	293207	28 00
10	200	2	293146	293141	31 00	10	200	2	293213	293208	31 00
15	200	3	293147	293142	34 00	15	200	3	293214	293209	34 00
25	200	5	293148	293143	38 00	25	200	5	293215	293210	38 00
50	200	10	293149	293144	46 00	50	200	10	293216	293211	46 00

3-Wire Wattmeters

3-Wire Wattmeters

5	100-200	1	293150	293136	28 00	5	100-200	1	293217	293203	28 00
10	100-200	2	293151	293137	31 00	10	100-200	2	293218	293204	31 00
15	100-200	3	293152	293138	34 00	15	100-200	3	293219	293205	34 00
25	100-200	5	293153	293139	38 00	25	100-200	5	293220	293206	38 00

Meters for Use With Transformers

*5	100	....	293176	293174	25 00	*5	100	....	293243	293241	25 00
*5	200	....	293177	293175	28 00	*5	200	....	293244	293242	28 00

POLYPHASE WATTMETERS

5	100	1	293166	293154	29 00	5	100	1	293233	293221	29 00
10	100	2	293167	293155	32 00	10	100	2	293234	293222	32 00
15	100	3	293168	293156	35 00	15	100	3	293235	293223	35 00
25	100	5	293169	293157	40 00	25	100	5	293236	293224	40 00
5	200	2	293170	293158	33 00	5	200	2	293237	293225	33 00
10	200	4	293171	293159	36 00	10	200	4	293238	293226	36 00
15	200	6	293172	293160	39 00	15	200	6	293239	293227	39 00
25	200	10	293173	293161	44 00	25	200	10	293240	293228	44 00
5	400	4	.....	293162	37 00	5	400	4	.....	293229	37 00
10	400	8	.....	293163	40 00	10	400	8	.....	293230	40 00
15	400	12	.....	293164	43 00	15	400	12	.....	293231	43 00
25	400	20	.....	293165	48 00	25	400	20	.....	293232	48 00

POLYPHASE RECORDING WATTMETERS

5	100	...	306428	306428	250 00	5	100	...	306429	306429	250 00
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Meters for Use with Transformers

*5	100	...	293181	293178	29 00	*5	100	...	293248	293245	29 00
*5	200	...	293182	293179	33 00	*5	200	...	293249	293246	33 00
*5	400	...	.....	293180	37 00	*5	400	...	.....	293247	37 00

RECORD PAPER

Paper for recording wattmeter, 1/4-inch per hour	0-1000 watts	Style No.	List Price
Paper for recording ammeter 1/4-inch per hour	0-1000 amperes	256391	\$0 35
		282494	35

AMMETERS

D-C. or A-C. 25-133 Cycle

2-Wire Ammeter

2-Wire Ammeter

15	...	.....	293183	\$22 00	15	...	.....	293250	\$22 00
10	...	.....	293184	25 00	10	...	.....	293251	25 00
15	...	.....	293185	28 00	15	...	.....	293252	28 00
25	...	.....	293186	32 00	25	...	.....	293253	32 00
50	...	.....	293187	40 00	50	...	.....	293254	40 00

3-Wire Ammeter

3-Wire Ammeter

5	...	.....	293188	25 00	5	...	.....	293255	25 00
10	...	.....	293189	28 00	10	...	.....	293256	28 00
15	...	.....	293190	31 00	15	...	.....	293257	31 00
25	...	.....	293191	35 00	25	...	.....	293258	35 00

2-Wire Recording Ammeter

2-Wire Recording Ammeter

5	1	.....	304348	250 00	5	1	.....	304145	250 00
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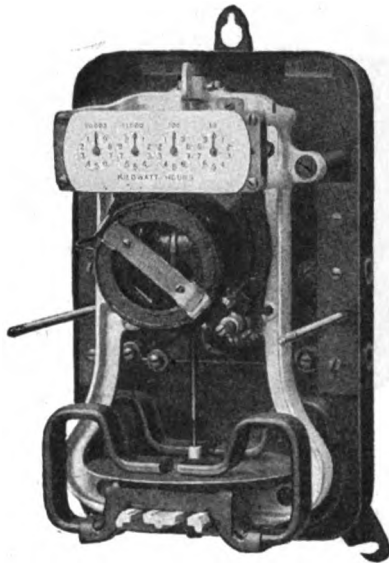
\*Style number and list price include 5-ampere meter of the voltage listed, for use with transformers, but do not include transformers. When a meter is desired with dial reading directly in kilowatts in the primary circuit, it should be ordered as: "Meter similar to Style No. (give Style No. of 100-volt meter from the above table), except with dial for...../5-ampere and..... 100-volt transformer;" or "Meter similar to Style No. (give Style No. of 200 or 400-volt meter from the above table), except with dial for...../5-ampere transformer." Price for the meter with dial as ordered will be the same as for meter listed. Transformers should be added at regular prices.

†When desired with dial direct reading in amperes, for use with a 2-wire or a 3-wire current transformer specify, "similar to Style No. ...." and also state primary and secondary capacity of current transformer to be used. No extra charge.

Order by Style Number

## TYPE CW-6 WATTHOUR METERS

FOR DIRECT-CURRENT CIRCUITS



METER WITH COVER REMOVED



METER COMPLETE

The Westinghouse type CW-6 watt-hour meters are designed in accordance with the latest meter practice and have incorporated in them all the improvements that experience has shown to be desirable.

### Construction

The meters are of the commutator type without iron in the magnetic circuit. The spherical armature is closely surrounded by circular field coils. Uniform brush tension at all degrees of wear is secured by making the brush tension dependent entirely upon gravity. Each brush consists of two small round wires held against the commutator by a small adjustable counterweight. Brushes and commutator are made of non-oxidizable material. The current winding consists of two flat coils of strap copper connected either in series or in parallel, depending on the capacity. In three-wire meters one

of the coils is connected in series with each side of the line. The mounting frame is cast of very hard and tough aluminum alloy, strong and rigid. This frame supports all of the meter mechanism. This construction makes it possible to remove the entire meter as a unit, without disturbing the adjustment.

**Bearings**—The main bearing of the Westinghouse type CW-6 meters is an improved form of ball bearing, consisting of a one-sixteenth-inch, highly polished steel ball between two sapphire cup jewels, one spring mounted and the other in a removable sleeve on the shaft. In operation this bearing has a rolling action that reduces friction and increases the life.

**Dimensions and Weights**—Overall dimensions: width 7½ inches, height 13 inches, depth 6¾ inches. Approximate net weight 13 pounds, boxed 32 pounds.

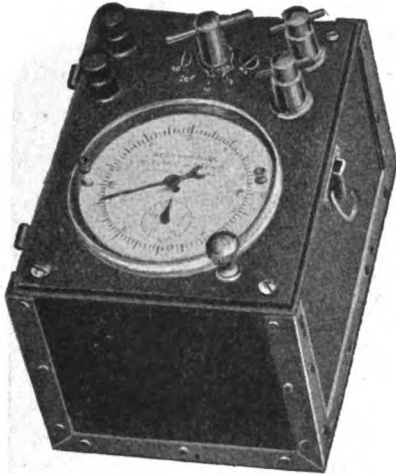
Cap. Amp.	TWO-WIRE METERS						THREE-WIRE*	
	100-120 VOLTS		200-240 VOLTS		500-600 VOLTS		200-240 VOLTS	
	Style No.	List Price	Style No.	List Price	Style No.	List Price	Style No.	List Price
5	162548	\$24 60	162558	\$27 75	244456	\$35 70	162568	\$27 75
10	162549	26 20	162559	31 75	244457	41 25	162569	31 75
15	162550	29 35	162560	37 30	244458	47 60	162570	37 30
25	162551	34 90	162561	42 85	244459	55 55	162571	42 85
50	162552	46 05	162562	54 35	244460	67 45	162572	56 35
75	162553	57 15	162563	65 90	244461	79 35	162573	69 90
100	162554	67 45	162564	77 35	244462	91 25	162574	83 35
150	162555	87 35	162565	99 35	244463	115 10	162575	107 15
300	162556	111 25	162566	127 00	244464	150 80	162576	146 80
600	162557	158 75	162567	178 50	244465	208 35		

\*Three-wire meters are for use on circuits of 100-120 volts between neutral and outside wire.

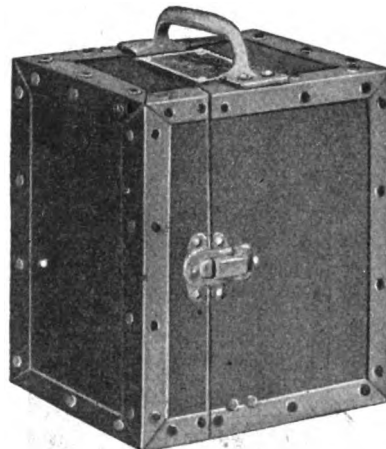
Order by Style Number

# TYPE OA PORTABLE STANDARD WATTHOUR METERS

## SINGLE-PHASE AND POLYPHASE



SINGLE-PHASE METER—COVER REMOVED



SINGLE-PHASE METER COMPLETE

### Application

Checking service meters with a portable standard watt-hour meter eliminates the use of a stop watch and makes the calibration very simple. As the number of revolutions made by the meter under test is compared directly with the number of revolutions made by the standard meter in the same time, the result indicates by very simple calculation the condition of the service meter. Moreover, both meters being connected in series, it is not necessary to keep the test load absolutely constant.

**Meters of other manufacture** may be tested by using the printed instructions and table of constants furnished with each meter.

### Construction

Because size and weight are the important considerations of a portable meter, this meter has been made as light and as small as possible. The type OA standard is smaller and lighter than the old type C standard.

**Case:** The case is made of micarta-duck material reinforced at the edge and corners with micarta-duck angles, held by rivets. Leather handles have been replaced by handles of metal and a molded glass top assures a well-lighted dial and dust-proofing.

**Zero Reset:** A zero reset, which returns both the large and small pointer to zero, is provided with this meter.

**Potential Switch**—This switch is valuable for its high insulation and quick-break features, which make possible accurate resettings of the large pointer.

**Bearings**—The main (lower) bearing is a ball-and-jewel bearing like that of the Westinghouse type OA watt-hour meter. The upper bearing is a self-oiling guide bearing.

**Register**—At normal load the pointer on the large dial revolves 25 times per minute and the pointer on the small dial once per minute. The small dial is subdivided into 25 divisions, each corresponding to a revolution of the main meter shaft, or a revolution of the large dial pointer; the large dial is subdivided into 100 divisions.

**Adjusting Switch**—The current and voltage setting is accomplished by means of a drum switch to which voltage and current coil leads are connected.

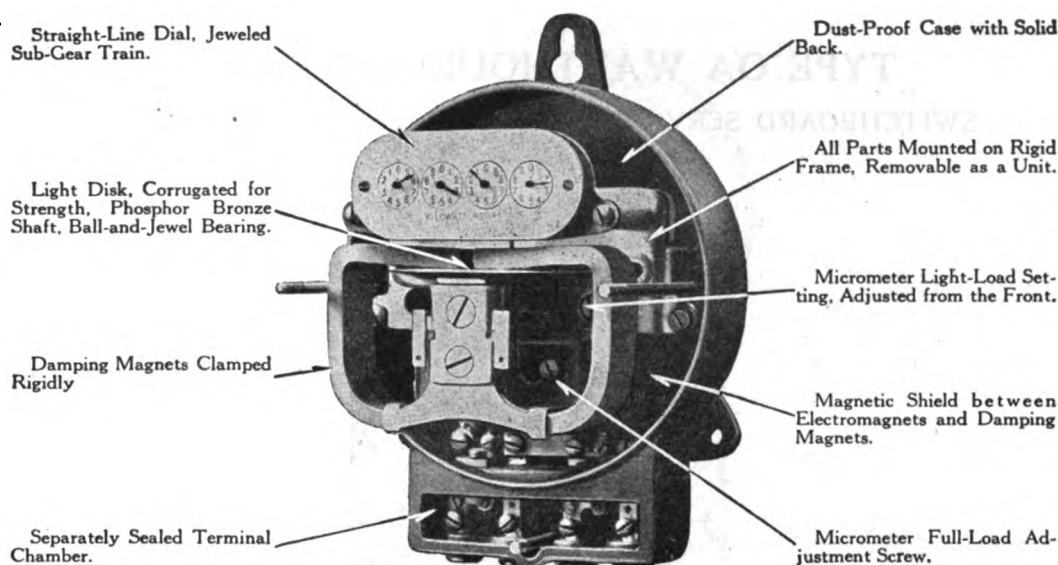
**Calibration**—The meter is essentially a service watt-hour meter with added refinements in workmanship and features tending to make it convenient for testing. Its calibration is guaranteed to be as per data furnished with the meter when it leaves the factory. This calibration is subject to variation however, like any other meter used for a similar purpose, due to the rough usage the meter is bound to receive in transportation and in service.

**Dimensions and Weights:** Single-phase,  $5\frac{5}{8} \times 7\frac{1}{4} \times 6\frac{3}{8}$  inches, 10 pounds. Polyphase,  $5\frac{5}{8} \times 8 \times 11\frac{1}{8}$  inches, approximate weight, 18 pounds.

Style number and list price include meter complete with flexible leads and push-button switch.

Single-Phase					Polyphase				
Volts	Full Load Amperes	STYLE No.		List Price	Volts	Full Load Amperes	STYLE No.		List Price
		25 cycle	60 cycle				25 cycle	60 cycle	
100-200	1- 5-10-20-40	362656	362652	\$90 00	100-200	1- 5-10-20-40	362664	362660	\$165 00
200-400	1- 5-10-20-40	362657	362653	95 00	200-400	1- 5-10-20-40	362665	362661	175 00
100-200	1-10-20-40-80	362658	362654	100 00	100-200	1-10-20-40-80	362666	362662	185 00
200-400	1-10-20-40-80	362659	362655	105 00	200-400	1-10-20-40-80	362667	362663	195 00

3-119A



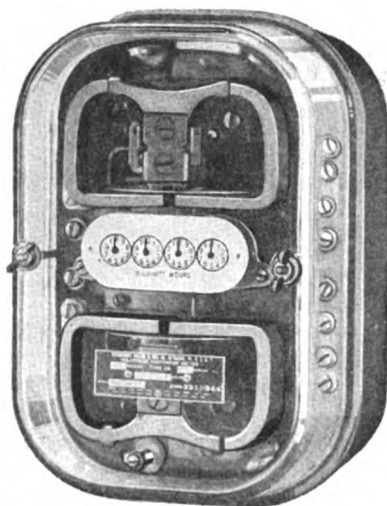
TYPE OA SINGLE-PHASE HOUSE-SERVICE WATTHOUR METER

### UNIT ASSEMBLIES

- |  |  |
|--|--|
| <p><b>1. Gear train:</b><br/>           Slow speed worm. (Less friction than high speed).<br/>           Jeweled step bearings.<br/>           Precision workmanship.</p>  | } <b>Minimum friction.</b>               |
| <p><b>2. Bearings:</b><br/>           Ball and cup jewels (Equivalent to infinite number of pivots).<br/>           Wear divided between two jewels.<br/>           Continuously oiled top bearing.<br/>           Low friction on all bearings.</p> | } <b>Unlimited life.</b>                 |
| <p><b>3. Moving Elements:</b><br/>           Light weight.<br/>           Perfectly balanced-mechanically-electrically.</p>  | } <b>Low jewel wear.</b>                 |
| <p><b>4. Electromagnet:</b><br/>           One piece current and voltage elements.<br/>           Absolutely permanent air gaps. (Cannot shift their relations).<br/>           Highly insulated-no service breakdown.</p>                           | } <b>Permanent performance.</b>          |
| <p><b>5. Permanent Magnets:</b><br/>           Best grade steel.<br/>           Liberal use of material. (High factor of safety).<br/>           Safe magnetic values. (Not affected by short circuits).</p>   | } <b>Permanent Calibration Insured</b>   |
| <p><b>6. Meter Case:</b><br/>           Dust and Moisture proof.<br/>           Light weight.<br/>           Accessibility.<br/>           Convenient to install.</p>  | } <b>Consistent mechanical features.</b> |
| <p><b>7. High Initial Accuracy:</b><br/>           Accurate with varying voltage.<br/>           Accurate with varying load.<br/>           Accurate with varying frequency.<br/>           Low Losses.</p>  | } <b>Consistent electrical features.</b> |
| <p><b>8. High Life Accuracy:</b><br/>           Perfect bearings.<br/>           Permanent magnets-scientifically designed.<br/>           Permanent air gaps.<br/>           Permanent performance.</p>   | } <b>Superior product.</b>               |

## TYPE OA WATTHOUR METERS

### SWITCHBOARD SERVICE—SINGLE-PHASE OR POLYPHASE



TYPE OA POLYPHASE WATTHOUR METER

Westinghouse type OA switchboard watthour meters are similar to type OA house-service watthour meters,\* except designed for switchboard service. These are especially noted for initial accuracy, long life accuracy, low maintenance cost, low losses, ready testing facilities, and other desirable features found in watthour meters of the highest grade.

#### Construction

All parts of the meter element are mounted on a supporting casting and can be removed from the case as a unit without changing the calibration. The electromagnet punchings are so clamped as to form one piece, thus the shifting of one part with reference to another is obviated. They form a closed magnetic circuit, a feature that insures permanency of calibration.

**Bearings**—The main (lower) bearing is a highly-polished and hardened-steel ball resting between two sapphire cup jewels, identical with that of the type OA meter.

**Case and Cover**—The one-piece case is of cast iron. The single joint (gasket fitted) between the case and the cover makes the meters unusually dust proof.

**Micrometer adjustment** is provided for both full load and light load.

**Testing**—Extra terminals are provided on the front of the meter under the cover to facilitate checking the meter while in service. These terminals are so arranged and connected by test links that the test meter can be inserted in the circuit from the front of the switchboard, for testing the switchboard meter, without opening the current transformer circuits. By these terminals and links, the switchboard-meter elements can likewise be disconnected from the transformer circuits, the current transformers being short-circuited, and connected to a test load and portable standard watthour meter.

**Polyphase meters**, when properly connected, indicate the true power in a two-phase three-wire or four-wire, or a three-phase three-wire circuit, regardless of the power factor or the degree of unbalance between phases.

The rated current capacity of the polyphase meter is that in each wire of the circuit; the rated voltage is that across one phase.

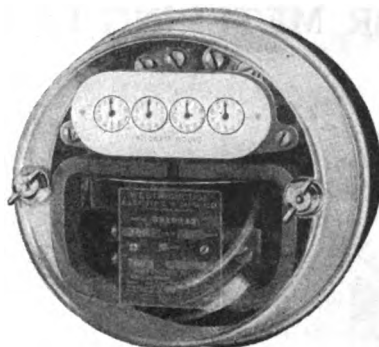
**Approximate Dimensions**—Single-phase,  $6\frac{5}{8}$  inches diameter by  $5\frac{1}{2}$  inches deep. Polyphase,  $10\frac{1}{2}$  inches high by 7 inches wide by  $5\frac{3}{4}$  inches deep.

**Approximate Weight**—Single-phase:  $11\frac{1}{2}$  pounds net; 20 pounds boxed. Polyphase: 21 pounds net; 40 pounds boxed.

\*For description of House Service Watthour Meters, see Section 3-A



TYPE OA SWITCHBOARD A-C. WATTHOUR METERS—Continued



TYPE OA SINGLE-PHASE WATTHOUR METER

SELF-CONTAINED METERS

Style number and list price include meter complete with glass cover as listed, ready for installation.

CAPACITY		SINGLE-PHASE, TWO-WIRE				POLYPHASE			
Volts	Amperes	Capacity, Kilowatts	STYLE No.		List Price	Capacity, Kilowatts	STYLE No.		List Price
			25-Cycle	60-Cycle			25-Cycle	60-Cycle	
100	5	0.5	276449	276467	\$35 00	1.0	276485	276503	\$51 00
100	10	1.0	276450	276468	38 00	2.0	276486	276504	55 00
100	15	1.5	276451	276469	40 00	3.0	276487	276505	58 00
100	25	2.5	276452	276470	43 00	5.0	276488	276506	63 00
100	50	5.0	276453	276471	48 00	10.0	276489	276507	72 00
100	75	7.5	276454	276472	51 00	15.0	276490	276508	80 00
200	5	1.0	276455	276473	37 00	2.0	276491	276509	56 00
200	10	2.0	276456	276474	39 00	4.0	276492	276510	60 00
200	15	3.0	276457	276475	41 00	6.0	276493	276511	62 00
200	25	5.0	276458	276476	44 00	10.0	276494	276512	67 00
200	50	10.0	276459	276477	50 00	20.0	276495	276513	77 00
200	75	15.0	276460	276478	53 00	30.0	276496	276514	85 00
400	5	2.0	276461	276479	44 00	4.0	276497	276515	64 00
400	10	4.0	276462	276480	46 00	8.0	276498	276516	67 00
400	15	6.0	276463	276481	48 00	12.0	276499	276517	70 00
400	25	10.0	276464	276482	51 00	20.0	276500	276518	78 00
400	50	20.0	276465	276483	56 00	40.0	275501	276519	86 00
400	75	30.0	276466	276484	60 00	60.0	276502	276520	94 00

METERS FOR USE WITH TRANSFORMERS

These meters are arranged for use with current transformers with 5-ampere secondaries, for current capacities higher than those listed in the preceding table. The 100-volt meters listed below can be used with voltage transformers with 100-volt secondaries for voltages higher than those listed.

Style number and list price include 5-ampere meter of the voltage listed, for use with transformers, but do not include transformers. When a meter is desired with register reading directly in kilowatt-

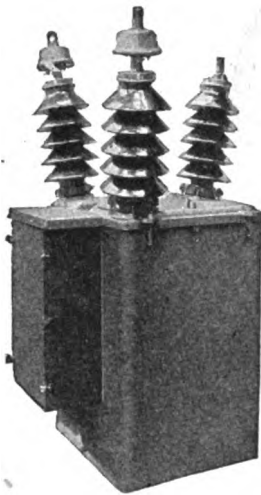
hours in the primary circuit, it should be ordered as: "Meter similar to Style No. (give Style No. of 100-volt meter from the following table), except with register for...../5-ampere and..... /100-volt transformer;" or "Meter similar to Style No. (give Style No. of 200 or 400-volt meter from the following table), except with register for...../5-ampere transformer." Price for the meter with register as ordered will be the same as for meter listed. Transformers should be added at regular prices.

CAPACITY		SINGLE-PHASE, TWO-WIRE				POLYPHASE			
Volts	Amperes	Capacity, Kilowatts	STYLE No.		List Price	Capacity, Kilowatts	STYLE No.		List Price
			25-Cycle	60-Cycle			25-Cycle	60-Cycle	
100	5	0.5	276521	276524	\$35 00	1.0	276529	276532	\$51 00
200	5	1.0	276522	276525	37 00	2.0	276530	276533	56 00
400	5	2.0	276523	276526	44 00	4.0	276531	276534	64 00

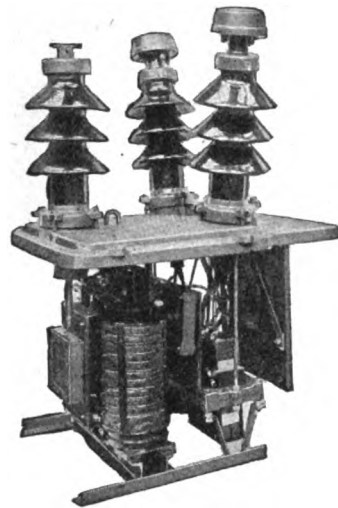
Note—The type C round polyphase watt-hour meter, where required for matching previous switchboard equipment, will be furnished at \$30.00 list price additional to the type OA price. The same meter in a rectangular case will be furnished at \$35.00 list price additional to the type OA price.

Order by Style Number

## OUTDOOR METERING EQUIPMENT



COMPLETE



CASE REMOVED

### Application

These metering equipments are furnished enclosed in weatherproof casings, for supplying service from high-voltage transmission lines, where the expense of a substation is not warranted.

### Construction

Each equipment consists of a standard polyphase watt-hour meter, two current transformers, a poly-phase voltage transformer, and three choke coils to protect the transformer windings against high-frequency disturbances; all enclosed in a sheet steel case with cast iron cover. The sheet steel case is subdivided into two compartments, one of which is filled with oil in which the transformers and choke coils are immersed, while the other serves to enclose the meter and meter panel. On the meter panel are also mounted two fuses to protect the voltage circuit of the meter and two calibrating links located

in the current circuit of the meter. The meter may be read or checked upon opening the hinged door which covers the entire front of the meter compartment. The arrangement is such that the entire outfit, including meter panel, can be raised out of the tank without disconnecting meter leads.

**Connections**—Three primary outlet terminals supported on the cover provide the necessary primary connections. A large handhole is provided in the cover of the metering equipment to facilitate connection or disconnection of the outlet terminals.

**Style number** includes outfit complete except watt-hour meter and oil. **List price** includes outfit complete with oil and watt-hour meter, Style No. 224369, calibrated as desired. **When ordering** specify style number of outfit, normal voltage, primary-current capacity,\* style number of watt-hour meter (Style No. 224369), calibration desired on watt-hour meter, and gallons oil.

### POLYPHASE 60-CYCLE EQUIPMENTS†

**Capacity:** Current transformers—50 volt-amperes; compensated for 25 volt-amperes.  
Voltage transformers—200 volt-amperes; compensated for 40 volt-amperes.

Rated Primary Voltage 115 Volts Secondary	APPROX. DIMENSIONS, IN.		Gal. Oil	APPROX. WT., LBS. WITHOUT OIL		5 TO 50 AMPERES				100 TO 200 AMPERES		
						STYLE No.‡			List Price‡	STYLE No.‡		List Price‡
	Floor Space	Ht.		Net	Box'd§	5, 10 Amperes	10, 20 Amperes	25, 50 Amperes		50, 100 Amperes	100, 200 Amperes	
11,500	28x41	44	42	1100	1350	272493	272494	272495	850 00	272496	272497	875 00
13,800	28x41	44	42	1100	1350	272498	272499	272500	875 00	272501	272502	900 00
11,500 or 23,000	29x41	56	45	1385	1650	272503	272504	272505	1175 00	272506	272507	1200 00
23,000	29x41	54	43	1400	1700	272508	272509	272510	1150 00	272511	272512	1175 00
34,500	35x44	60	70	1710	2100	272513	272514	272515	1500 00	272516	272517	1525 00
44,000	46x50	83	153	2530	3000	272518	272519	272520	2300 00	272521	272522	2325 00
66,000	50x60	100	270	2600	3100	272523	272524	272525	3275 00	272526	272527	3300 00

†Two or Three-Phase Four-Wire Service—Equipments listed above are not suitable for two-phase four-wire or three-phase four-wire service; equipments for this service can be supplied on special order, prices on request.

‡Voltage Below 11,500—For outfits for voltages below 11,500 see pages on "Outdoor Switching and Metering Equipment," Section 2B.

\*The current transformers have two primary windings which can be connected in series or parallel to give the lower or higher current rating listed. Order should specify which current rating is desired so proper connection and meter calibration can be made at the works.

†These equipments may also be obtained for use with 25 cycles. Prices upon application.

§Equipments are regularly shipped in their tanks without oil—oil is shipped separately and weighs approximately 7 pounds net per gallon and 8 1/2 pounds gross per gallon. On receipt at destination equipments should be filled with clean dry oil immediately.

‡See "style number and list price include" above.

## TYPE BT AUTOMOBILE AMMETERS

### DIRECT-CURRENT—1 $\frac{7}{8}$ -INCH DIALS—1 $\frac{1}{8}$ -INCH SCALES



#### Application

The type BT automobile ammeter is for use on the automobile dash or cowl when electric generators or storage batteries supply the power for starting, ignition and lighting. On motor boats, yachts, aerial craft, small direct-current switchboards, farm lighting panels and battery charging panels this ammeter should also find ready application.

#### Distinctive Features

This instrument has no electrical connections or coils.

Possibility of ground is prevented by the absence of terminals, coils or insulation.

Since there are no coils, there can be no short-circuits, burn-outs or "opens"; no possible amount of overload can affect the instrument.

There can be no damage or annoyance caused by loosening of connection studs when attempting to install or disconnect an instrument.

The development of a new non-residual vacuum-annealed steel eliminates the variable zero error and makes possible the peculiar construction of the instrument.

Simplicity, ruggedness, compactness and reliability at an attractively low price.

For their intended application, the accuracy of these instruments is more than sufficient. Particular attention has been given to accuracy between 10 and 15 amperes in the charge direction, in order that the adjustments of generators or regulators can be checked.

Ease and simplicity of installation.

#### Principle of Operation

The type BT instrument, having no electrical coils or connections, involves a radical departure from all previous ammeters. A modification of the polarized vane construction is used. The case has a magnetic yoke projecting from the rear, through which is passed the current carrying cable or wire.

This yoke has pole pieces extending into the inside of the ammeter and these poles vary in magnetic polarity and strength corresponding to the direction of the current passing through the cable. The electro-magnet is made of a specially prepared alloy-steel which acts without any residual magnetism error.

There is also a fixed permanent magnet inside the instrument with poles located at right angles to the poles formed by the yoke. Pivoted on a shaft in the center of this group of poles is a soft iron vane, which takes up a position corresponding to the relative strength of the permanent magnet and the electro-magnet. The shaft carries the usual pointer, which indicates on the calibrated scale the value of the current.

The movement is carefully balanced and light in weight. Vibration and jars of the car over rough roads produce no objectionable effect upon the action of the instrument, making any separate damping arrangement unnecessary.

Installation is very simple; instead of wiring the meter to the car system with two pieces of wire or cable with connections and clips to the meter studs, involving soldering to clips and attaching to studs, the cable used for dash wiring is merely passed through the yoke. The magnetic yoke will pass a cable of  $\frac{1}{4}$ -inch overall diameter.

#### Construction

**Case**—The case corresponds with the standard S. A. E. dimensions, and is arranged to be attached to the instrument board or switch plate by means of a clamp in the rear or by means of three mounting screws through the flange.

**Finish**—The standard finish is nickered rim and black dial with white pointer and figures. Frosted dials with black pointer and figures are also furnished.

**Dial**—Great care has been taken to design the dial to give maximum readability and pleasing effect. Believing that the sole function of an am-

TYPE BT AUTOMOBILE AMMETERS—Continued

meter is to indicate amperes, the name of the manufacturer is made as small as possible, as in watch dial designs. For similar reasons, it is recommended not to use the ammeter dial to give the name of the car builder when making applications to automobiles.

**Rims**—Three standard styles of rim are provided, viz, narrow, rounded and beaded rims for rear clamping cases to match up with the more popular styles of oil pressure gauge rims and a wider rim with three mounting screw holes for front mounting.

**Capacities**—Only the 20-0-20 amperes and 30-0-30 amperes capacities are listed. Ammeters

of smaller capacities such as 10-0-10 amperes and 15-0-15 amperes can be produced specially. Left zero ammeters for special purposes can also be furnished. These instruments are self-contained.

**Oil Pressure Gauges**—We are also prepared to furnish oil pressure gauges to match these ammeters. Prices on application.

**Dimensions**—Rear mounting type, overall dimensions are, 2¼ inch in diameter and ½ inch thick. Front mounting type 2½ inches in diameter and ½ inch thick.

**Approximate Weight**—Net 2 ounces, boxed 4 ounces

LIST PRICES

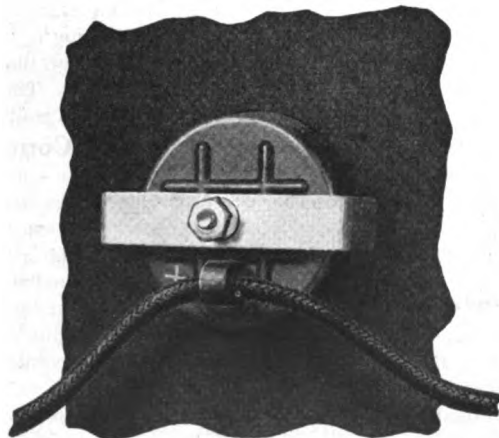
Capacity	Dial	Rim (Nickel)	Used	Front Flange-Mounting Style Number	Rear Clamp-Mounting Style Number	List Price
20-0-20	Black	Beaded	Metal Dash	375016	356401	\$1 50
20-0-20	Black	Rounded	Metal Dash		356402	1 50
30-0-30	Black	Beaded	Metal Dash	375375	356403	1 50
30-0-30	Black	Rounded	Metal Dash		356404	1 50
20-0-20	Frosted	Beaded	Metal Dash	375377	356405	1 50
20-0-20	Frosted	Rounded	Metal Dash		356406	1 50
30-0-30	Frosted	Beaded	Metal Dash	375379	356407	1 50
30-0-30	Frosted	Rounded	Metal Dash		356408	1 50
20-0-20	Black	Beaded	Wood Dash	375374	356409	1 50
20-0-20	Black	Rounded	Wood Dash		356410	1 50
30-0-30	Black	Beaded	Wood Dash	375376	356411	1 50
30-0-30	Black	Rounded	Wood Dash		356412	1 50
20-0-20	Frosted	Beaded	Wood Dash	375378	356413	1 50
20-0-20	Frosted	Rounded	Wood Dash		356414	1 50
30-0-30	Frosted	Beaded	Wood Dash	375380	356415	1 50
30-0-30	Frosted	Rounded	Wood Dash		356416	1 50
20-0-20	Black	Beaded [For use on Ford Cars]		375690*	.....	1 50

ACCESSORIES AND REPAIR PARTS

Style Number	Description	List Price
357270	Beaded Rim—Complete with glass—Nickel finish	\$0 35 each
357271	Rounded Rim—Complete with glass—Nickel finish	35 each
374981	Wide Rim—Complete with glass—Nickel finish	35 each
356367	Glass only	10 each
356364	Rear Clamp for metal dash ¼" to ½"	10 00 per C
357265	Rear Clamp for wood dash ¼" to ½"	10 00 per C
356379	Car wiring terminal clip	5 00 per C

This terminal clip is the proper size to pass through the instrument yoke, and is supplied separately where cars are not provided with a suitable terminal clip for the cable which passes through the instrument yoke.

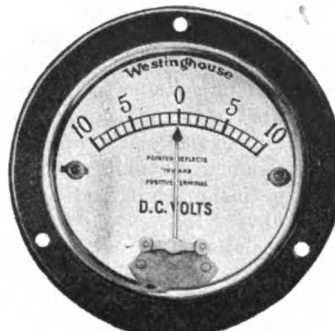
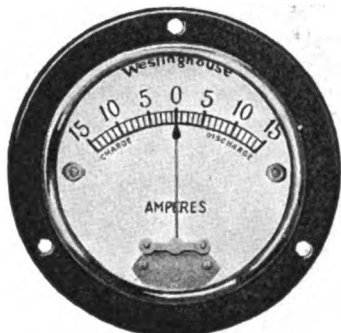
\*Special case and rim to fit standard switch mounting of Ford cars.



REAR VIEW OF BT AMMETER—SHOWING MOUNTING CLAMP AND BATTERY CABLE

## TYPE BI INSTRUMENTS

### DIRECT-CURRENT—2-INCH DIALS—1½-INCH SCALES



#### Application

These instruments are for use on the automobile dash or cowl when electric generators, motors, and storage batteries for starting, ignition, and lighting are used. They also find ready application on motor boats, yachts, aerial craft, small direct-current switchboards, farm-lighting panels and for charging batteries.

These instruments are designed with special regard to ruggedness, simplicity, readability and appearance.

#### Principle of Operation

The type BI instrument utilizes the polarized vane construction, comprising a moving soft-iron vane polarized by a stationary permanent magnet and deflects the pointer over the scale by the action of the stationary current or voltage coil. The pointer of the zero center voltmeter moves toward the positive terminal and this forms a convenient polarity indicator. No springs or moving coils are used, thus resulting in great simplicity and ruggedness. The indications are dead-beat.

#### Construction

Mounted in open-faced circular pressed-metal cases with terminal studs for rear connection.

**Capacities**—Instruments are self-contained in the capacities listed, and no external shunts or resistors are required, except for the 50 volt and 130 volt voltmeters. The ammeters are not damaged by momentary short circuits up to 500 amperes.

**Finish**—The case finish is black rubberoid with a brightly polished nickel rim, holding the glass. The dials are of metal, black or white nickel, as desired.

**Mounting Accessories**—The "mounting details" included in some of the listed styles comprise three standard machine screws 1 inch long and a circular punched metal ring tapped for receiving the screws. These make nuts unnecessary for clamping the instrument to either a metal or wooden dash. Where it is desired to screw directly into the dash the styles listed "without mounting details" should be ordered.

**Rear Mounting Flush Type**—These instruments are identical to the standard instrument with the exception that there is no hole in the flange mounting, the arrangement for mounting being from the rear of the panel by means of the mounting clamp listed below.

**Dimensions**—The type BI instrument has a diameter over its flange of approximately 2½ inches and requires an opening in the dash of approximately 2 inches; exact mounting dimensions on request.

**Weights**—Net 4 ounces, boxed 8 ounces. Individual units can be shipped by mail.

#### Prices

Style number and list price include instrument with or without mounting accessories as specified.

Scale	STYLE NO.			List Price
	Black Dial Flush Type	WHITE NICKEL DIAL Flush Type	NICKEL DIAL Projecting Type	
<b>Ammeters Without Mounting Details</b>				
15-0-15	257775	270436	.....	\$3 00
20-0-20	257777	270438	.....	3 00
30-0-30	257779	270440	.....	3 00
<b>Ammeter Rear Mounting Flush-Type†</b>				
20-0-20	289106	289130	.....	3 00
30-0-30	289129	289131	.....	3 00
<b>Ammeters With Mounting Details</b>				
5-0-5	.....	328909	328914	3 15
10-0-10	.....	328910	328915	3 15
15-0-15	257776	270437	328916	3 15
20-0-20	257778	270439	328917	3 15
30-0-30	257780	270441	328918	3 15
<b>Voltmeters with Mounting Details</b>				
3-0-3	.....	320977	328902	6 00
5-0-5	.....	320978	328903	6 00
10-0-10	.....	320979	328904	6 00
15-0-15	.....	320980	328905	6 00
30-0-30	.....	320981	328906	6 00
50-0-50	.....	320982	328907	7 00
130-0-130	.....	320983	328908	8 00
<b>Mounting Clamp</b>				
Description		*Style No.		List Price
For Metal Dash.....		251488		\$0 15
For ¼-inch Wood Dash.....		251489		15
For ½-inch Wood Dash.....		251490		15
For ¾-inch Wood Dash.....		251491		15

\*The mounting clamp style numbers include necessary nuts and terminal clips for assembling to dash and making connections.

†Mounting clamp not included.

## DIRECT-CURRENT SWITCHBOARD INSTRUMENTS

An analysis of instrument requirements in various activities led to the conception of an ideal instrument which would have an almost universal application—universal in application, in that the instrument should be suitable for all varieties of use and not limited to the needs of any one instrument or kind of service—ideal in construction, in that the instrument should be accurate, permanent, easy to manufacture, and of a pleasing appearance.

The above analysis led to the adoption of the bipolar D'Arsonval principle of operation generally known as the permanent magnet moving coil type, as being the ideal construction and the most universal in application.

In order to meet the requirements as to sizes of dials it was found that by designing two sizes of movements of identical construction but with one twice the linear dimensions of the other, switchboard instruments could be produced in cases

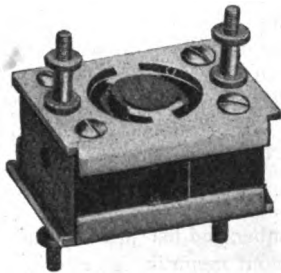


FIG. 1—POLE-PIECE CORE ASSEMBLY

2 $\frac{1}{8}$  inches, 3 $\frac{1}{2}$  inches, 4 $\frac{3}{8}$  inches and 7 $\frac{1}{2}$  inches in diameter. A general description of one movement will therefore apply equally to all.

By the use of the construction shown in Fig. 1, an accurate and uniform air gap is assured. A permanent magnet of steel which has been specially treated to assure permanence over a long period of time, maintains flux in the air gap. A coil of wire is free to move in this air gap and is wound on an aluminum frame for damping purposes. It is supported by hardened steel pivots on polished jewel bearings.

The pivots are clamped to the coil in the novel method shown in Fig. 2. This gives a strong and reliable method of support and assures at all times that the pivots are in the center of the coil.

The tapered seamless tubular construction for instrument pointers is entirely novel, and is obviously the strongest possible construction, considering the weight. Ordinary aluminum tubing, as largely used for pointers previously, is of uniform strength at all points, whereas the strength should be naturally increased toward the center of motion. This has led to a multitude of designs of pressed

sheet metal forms or truss-constructions for pointers, none of which, however, can compare in natural strength and simplicity with the tapered tube.

The dial is made from sheet metal, lithographed white or black. The white dial is standard, but black dial instruments are available and can be



FIG. 2—COIL WITH PIVOTS

shipped on application. The metal dial is an advantage over the bristol board dial because it is unaffected by heat or moisture, thus forming another important quality feature in these types.

Instruments can be used to measure high frequency currents by passing the current to be measured through a heating strip and then measuring the temperature by a thermocouple mounted on the strip. These instruments can be used to measure commercial frequency circuits where the overloads which would burn out the heating strip can be guarded against. The low capacity ammeters can be used as alternating-current galvanometers and are equipped with external heaters and thermocouples mounted in bulbs.

The types BX and CX instruments, altho they are small, retain the accuracy and sensitivity of the larger instruments, so that accurate, reliable instruments are now available to suit any size panel. The round open face construction characteristic of Westinghouse instruments has, of course, been retained, and all except the 7 $\frac{1}{2}$ -inch instruments can be obtained in both flush and projecting mounting.

The standard finish of case is dull black Japan having very durable qualities.

Types CX, DX and SX instruments have external zero adjusters. All instruments are back connected. A great variety of standard ranges is

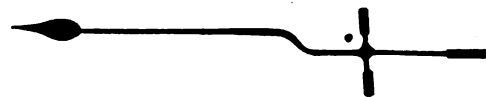


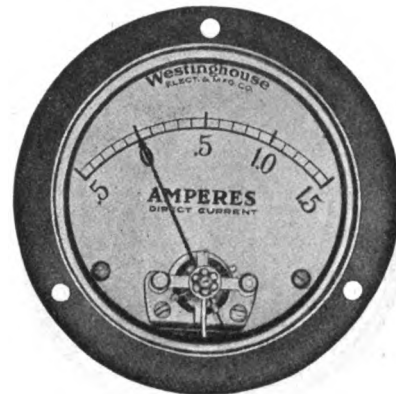
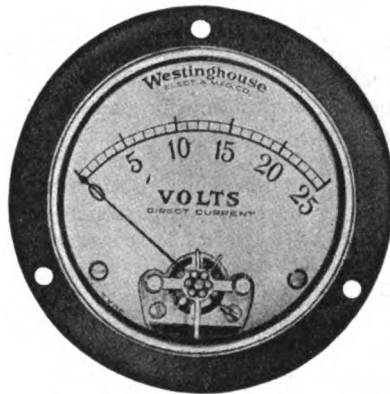
FIG. 3—TAPERED TUBULAR POINTER

listed. The smaller instruments are restricted within certain limits. These limits have been carefully selected to give maximum readability and sufficient insulation to be safe for the operator.

Special ranges approximating these limits can be obtained, prices on which will be quoted upon request.

DIRECT-CURRENT SWITCHBOARD INSTRUMENTS—Continued

**TYPE BX INSTRUMENTS**  
For Direct Current or Radio-Frequency Alternating Current



**Application**

The type BX instruments are for use on small panels where accurate readings are required. These instruments are used in radio work where it is desirable to measure filament and plate currents or voltages and check the A and B batteries; also on farm lighting and battery charging panels, automobile and aircraft dash-boards; in marine and electro-medical service. Sensitive galvanometers can be used for research and investigation work.

The only limitation on the application of these instruments is one of observation. They can be used in all cases where compactness is required and where, in making observations, the operator will be within three feet of the instrument.

**Dimensions**—Instruments are 2 1/8 inches in diameter over the flange base. The diameter of the body is 2 inches.

**Approximate weights**—Net 4 ounces, boxed 8 ounces.

**D-C. Ammeters**  
STYLE NOS.

Capacity Uncal.	FLUSH MOUNTING		PROJECTION MOUNTING		List Price
	White Dial	Black Dial	White Dial	Black Dial	
1	287086	287086	289458	289459	\$10 00
2	284918	284264	289144	284294	10 00
3	284919	284265	289145	284295	10 00
5	284920	284266	289146	284296	10 00
10	284921	284267	289147	284297	10 00
15	284922	284268	289148	284298	10 00
*25	284923	284269	289149	284299	10 00
1/4-0-1-1/2	284924	284270	289150	284300	10 00
20-0-20	289169	284271	289183	284301	10 00
25-0-25	284925	284928	289161	289164	10 00
30-0-30	284927	284930	289153	289156	10 00
	284926	284929	289152	289155	10 00

**D-C. Voltmeters**

3	284931	284272	289157	284302	10 00
8	284932	284940	289158	289168	10 00
10	284933	284941	289159	289167	10 00
16	284934	284942	289180	289168	10 00
25	284935	284273	289181	284303	10 00
30	283694	283696	283704	283708	10 00
40	283695	283697	283705	283707	11 00
†50	284936	284274	289182	284304	11 00
†75	284937	284275	289183	284305	11 00
†120	284938	284276	289184	284306	12 00
†150	284939	284277	289185	284307	12 00

**D-C. Milliammeters**

100	289170	284278	289184	284308	10 00
150	289171	284279	289185	284309	10 00
250	289172	284280	289186	284310	10 00

**Radio-Frequency A-C. Ammeters**

0.1	302368	284281	302373	284311	20 00
0.2	302367	284282	302372	284312	20 00
0.3	302366	284283	302371	284313	20 00
0.4	302365	284284	302370	284314	20 00
0.5	302364	284285	302369	284315	20 00
0.6	289173	284286	289187	284316	20 00
0.8	289174	284287	289188	284317	20 00
1.0	272913	284288	289189	284318	15 00
1.5	289176	284289	289190	284319	15 00
2.0	289177	284290	289191	284320	15 00
3.0	289178	284291	289192	284321	15 00
4.0	289179	284292	289193	284322	15 00
6.0†	289180	284293	289194	284323	15 00

\*Higher capacities can be obtained using external shunts.

†Supplied with external resistor mounted on back of meter. Higher capacities can be supplied. Prices on request.

‡For higher capacities see types CX or DX.

DIRECT-CURRENT SWITCHBOARD INSTRUMENTS—Continued

TYPE CX INSTRUMENTS

For Direct Current or Radio-Frequency Alternating Current



The type CX instruments are larger than type BX instruments. Their application is similar to that of the type BX instrument for panels where the operator wishes to make observations at distances of from six to ten feet. They find particular application on small isolated panels such as the larger sizes of battery charging panels, farm lighting sets, etc. The larger sizes of radio sets where space is not a limiting factor should be equipped with these instruments.

**Size**—These instruments are 3½ inches in diameter.

**Approximate Weight**—One pound net. Two pounds boxed.

D-C. Ammeters

Capacity †Uncl.	FLUSH MOUNTING		PROJECTION MOUNTING		List Price
	White Dial	Black Dial	White Dial	Black Dial	
1.5	312066	312067	312129	312130	\$11 00
2	312048	312057	312111	312120	11 00
3	312049	312058	312112	312121	11 00
4	312050	312059	312113	312122	11 00
6	312051	312060	312114	312123	11 00
8	312052	312061	312115	312124	11 00
10	312053	312062	312116	312125	11 00
15	312054	312063	312117	312126	11 00
*25	312055	312064	312118	312127	11 00
20-0-20	312056	312065	312119	312128	11 00
30-0-30	318843	318845	318851	318853	11 00
	318844	318846	318852	318854	11 00

D-C. Milliammeters

100	312078	364324	312141	364327	11 00
150	312079	364325	312142	364328	11 00
250	312080	364326	312143	364329	11 00

D-C. Voltmeters

1	323836	323843	323850	323857	11 00
5	323837	323844	323851	323858	11 00
8	318847	318849	318855	318857	11 00
10	323838	323845	323852	323859	11 00
15	323839	323846	323853	323860	11 00
16	318848	318850	318856	318858	11 00
25	323840	323847	323854	323861	11 00
150	323841	323848	323855	323862	12 00
175	323842	323849	323856	323863	12 00
150, 100	312068	312072	312131	312135	14 00
1150	312069	312073	312132	312136	14 00
1300	312070	312074	312133	312137	18 00
150, 500	312071	312075	312134	312138	21 00

Radio-Frequency A-C. Ammeters

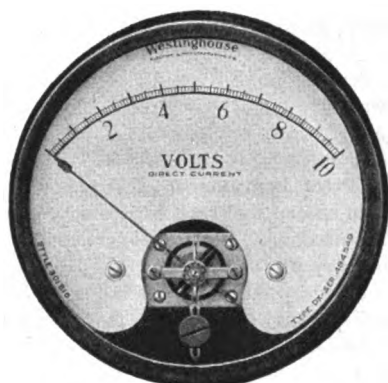
Uncl.	312109	312110	312172	312173	25 00
0.15	312081	312095	312144	312158	25 00
0.2	312082	312096	312145	312159	25 00
0.3	312083	312097	312146	312160	25 00
0.4	312084	312098	312147	312161	25 00
0.6	312085	312099	312148	312162	25 00
0.8	312086	312100	312149	312163	25 00
1.0	312087	312101	312150	312164	25 00
1.5	312088	312102	312151	312165	25 00
2.0	312089	312103	312152	312166	25 00
3.0	312090	312104	312153	312167	25 00
4.0	312091	312105	312154	312168	25 00
6.0	312092	312106	312155	312169	25 00
8.0	312093	312107	312156	312170	25 00
**10.0	312094	312108	312157	312171	25 00

\*Higher capacities can be used with external shunts.  
 †For use with type G shunts.  
 \*\*Higher capacities, see type DX.  
 ‡Supplied with external resistor.  
 Higher capacities can be supplied. Prices on request.



DIRECT-CURRENT SWITCHBOARD INSTRUMENTS—Continued

TYPE DX INSTRUMENTS



TYPE DX VOLTMETER

Application

The type DX instruments are suitable for general switchboard application. The scales have been made very long, considering the size of the case so that maximum readability is obtained for small board space taken. With the present day growth of generating and substations located in large cities where real estate values are high, there is a demand for smaller instruments with longer and more legible scales. The DX instruments were designed to meet this demand and type DY alternating-current instruments of same size are available for uniformity. It is therefore possible to get a complete line of direct and alternating-current instruments 4 3/8 inches diameter. The DX instruments are made as direct-current ammeters and voltmeters, radio frequency a-c. ammeters, galvanometers, speed indicators, temperature indicators, differential voltmeters, ground detector voltmeters, double-reading ammeters and voltmeters, pyrometer millivoltmeters, and micro-ammeters. Ammeters, voltmeters, etc., insulated for 4000 volts, can be obtained.

The standard style numbers are for instruments having projecting or front of board mounting cases.

These instruments are also made with flush type cases.

Compact measuring instruments on the Edison three wire systems are desirable. An instrument

has been developed known as type DX duplex for this service. The illustration shows two ammeter movements which have scales close together for easy comparison. Combination voltmeter and ammeter movements can be mounted in these cases as desired, also speed indicators or temperature indicators. Prices on request.

Ammeters

Capacity	STYLE Nos.		List Price
	White Dial	Black Dial	
Uncal.	301803	319087	\$18 00
1	301804	319088	18 00
5	301805	319089	18 00
10	301806	319090	18 00
15	301087	319091	18 00
25	301808	319092	20 00
* 50	364335	364352	18 00
* 75	364336	364353	18 00
* 100	364337	364354	18 00
* 150	364338	364355	18 00
* 200	364339	364356	18 00
* 250	364340	364357	18 00
* 300	364341	364358	18 00
* 400	364342	364359	18 00
* 500	364343	364360	18 00
* 600	364344	364361	18 00
* 800	364345	364362	18 00
*1000	364346	364363	18 00
*1200	364347	364364	18 00
*1500	364348	364365	18 00
*2000	364349	364366	18 00
*2500	364350	364367	18 00
*3000	364351	364368	18 00

\*For use with external shunts.

Voltmeters

10	301810	319095	18 00
25	301811	319096	18 00
50	301812	319097	19 00
75	301813	319098	19 00
150	301814	319099	20 00
300	301815	319100	24 00
500	301816	319101	30 00
600	301817	319102	38 00
750	301818	319103	45 00

Radio-Frequency A-C. Ammeters

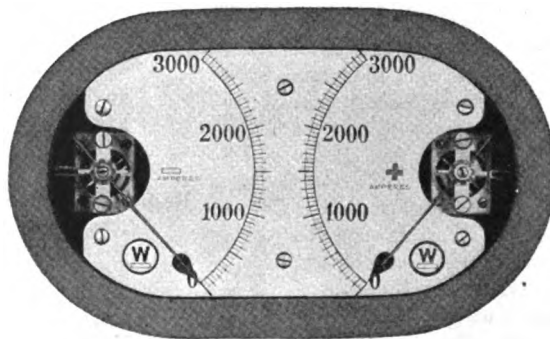
6	301819	319106	25 00
8	301820	319107	25 00
10	301821	319108	25 00
15	301822	319109	25 00
20	301823	319110	25 00

Uncalibrated style numbers can be calibrated for use with external shunt as desired.

Higher capacities can be obtained using special current transformer listed on the following page.

Other capacities other than those listed are available.

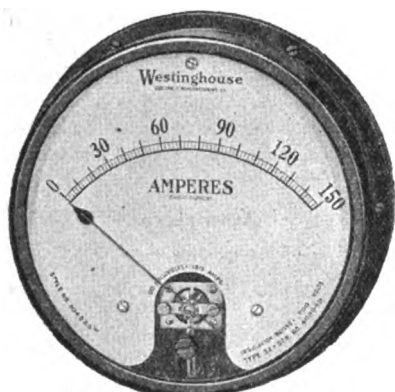
For prices and delivery inquire of nearest office.



TYPE DX DUPLEX AMMETER

DIRECT-CURRENT SWITCHBOARD INSTRUMENTS—Continued

TYPE SX INSTRUMENTS



TYPE SX AMMETER

Application

The type SX instruments are for general switchboard use and match up in appearance with the type SY line of a-c. instruments.

**Dimensions**—The overall diameter is 7 $\frac{1}{8}$  inches; the depth is 2 $\frac{1}{2}$  inches.

**Approximate Weight**—Nine pounds net; 20 pounds boxed.

**Shunts**—Type G shunts are used with type SX shunt-type ammeters. For description and prices see page on "Shunts for d-c. Ammeters," Section 3-B of this catalogue.

Special Instruments

**Differential Voltmeters** are used for paralleling generators. They have the zero in the center of the scale and are arranged to read zero when equal voltages of the same polarity are applied. Differential voltmeters require external resistors. Prices quoted on request.

**Ground Detector Voltmeters**, also called "leakage detectors," can be supplied on special order arranged to read zero when two voltages of opposite polarity are applied. These instruments are also used for indicating unbalanced voltages of three-wire circuits. Prices quoted on request.

**Double reading Ammeters and Voltmeters** with zero at any point on the scale and graduated for readings in both directions will be furnished on special order. Prices quoted on request.

**Pyrometer Millivoltmeter** for use with thermoelectric couples can be adjusted for eight millivolts up to any millivoltage full scale. The current required at full scale is 0.002 amperes. The scale can be calibrated in millivolts or degrees. Prices quoted on request.

**Temperature Indicators**—Voltmeters arranged as resistance type temperature indicators can be furnished for reading temperature of machinery, ovens, etc. See pages on Temperature Indicators.

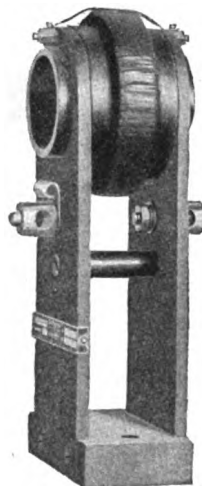
**Speed or Frequency Indicators** including a voltmeter and magnet can be furnished. See pages on Speed Indicators.

**Cents-Per-Hour Indicators**—The self-contained ammeter can be furnished with dials to indicate

"Cents Per Hour" (when voltage is specified) for use in displaying or demonstrating domestic-electric devices, on Edison d-c. systems such as: irons, washers, fans, heaters, etc. These can be made either front or rear-connected as desired. Prices on request.

**Water Proof Instruments**—Instruments can be supplied in special waterproof cases with glass only over scale marking. These are particularly applicable to navy use and have been approved by them.

**Radio-Frequency Current Transformer**—This is a through type current transformer suitable for measuring radio frequency circuits of heavy capacities. This transformer has a one ampere secondary and can be used with any one ampere thermocouple instrument. The normal ratio is 200 to 1 but by putting the primary through a number of times this ratio can be cut down in proportion. It can also be used for measuring high frequency induction furnaces. List price \$35.00 each.



RADIO-FREQUENCY CURRENT TRANSFORMER

D-C. Ammeters

For Use with Shunts. For Voltages Up to 750

Capacities Uncl.	STYLE Nos.		List Price
	White Dial	Black Dial	
*15	293399	293400	\$30 00
*25	304521	370881	30 00
*50	304522	370882	30 00
*75	304523	370883	30 00
*100	304524	370884	30 00
*150	304525	370885	30 00
*200	304526	370886	30 00
*250	304527	370887	30 00
*300	304528	370888	30 00
*400	304529	370889	30 00
*500	304530	370890	30 00
*600	304531	370891	30 00
*800	304532	370892	30 00
*1000	304533	370893	30 00
*1200	304534	370894	30 00
*1500	304535	370895	30 00
*2000	304536	370896	30 00
*2500	304537	370897	30 00
*3000	304538	370898	30 00
	304539	370899	30 00

D-C. Voltmeters

150	293402	293407	35 00
300	293403	293408	38 00
600	293404	293409	42 00
750	293405	293410	45 00

Radio-Frequency A-C. Ammeters

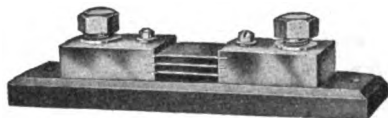
6	306227	306232	37 00
8	306228	306233	37 00
10	306229	306234	37 00
15	306230	306235	37 00
120	306231	306236	37 00

Other capacities are available. Prices and deliveries can be obtained from nearest office.

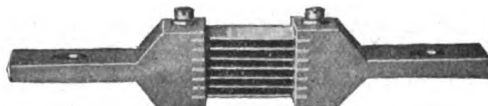
\*All calibrated ammeters are for use with external shunts. These styles include leads but shunts should be ordered from page 513.

†Higher capacities can be obtained using special radio-frequency transformers, listed above.

## TYPE G SHUNTS FOR D-C. AMMETERS SWITCHBOARD TYPE



250 AMPERE TYPE G SHUNT



500 AMPERE TYPE G SHUNT

The type G shunts are designed for use on horizontal laminated bus bars, but will operate in any position without overheating. The terminal castings above 300 amperes are slotted to receive one  $\frac{1}{4}$ -inch copper bar per slot. The sizes ranging from 10 to 300 amperes are mounted on a light micarta strip which takes all strain that might arise from bus-bar distortion, from the terminal lug and manganin plate joint.

### Temperature Coefficient

The resistance plates of the type G shunts have a negligible temperature coefficient and thermo-electromotive force, thus avoiding errors due to heating, which may amount to several per cent in other resistor materials.

### Temperature Rise

Type G shunts operate at a temperature rise of  $30^{\circ}$  C. if connected to bus-bars of ample conductivity when carrying two-thirds of their rated current which should correspond to the normal full load rating of the circuit.

### Interchangeability

Type G shunts are adjusted for 50 millivolts drop at full rated current, and are interchangeable with certain other standard makes of the same rating.

### Rating

Shunts are rated according to full scale rating of the ammeters which, in general, should be about 50 per cent in excess of the full load current of the circuit. They are intended primarily for Westinghouse ammeters but can be used with any instrument requiring 50 millivolts for full scale deflection.

Larger capacities shunts than listed can be furnished on special order, prices on application.

It is recommended, however, that wherever possible, instead of ordering larger shunts for measurement of heavy capacity circuits, several of the smaller shunts be connected in multiple, each shunt being provided with separate leads to the ammeter terminals. For example, use four 5000 ampere shunts in connection with a 20,000 ampere ammeter, etc.

This arrangement will be found to be less expensive, more accurate and more desirable from an operating viewpoint than using a single 20,000 ampere shunt.

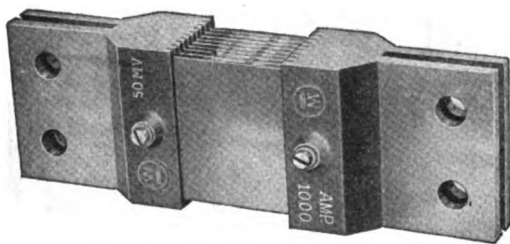
### Portable Shunts

Shunts for use with portable instruments are listed on the pages covering the portable instruments. Type G shunts are also suitable for portable service with shunted-type ammeters or millivoltmeters requiring 50 millivolts for full scale deflection. The accuracy of the combination is lower than when 100 millivolt shunts and instruments are used, unless the air temperature is between  $20^{\circ}$  and  $30^{\circ}$  C., as 50 millivolt instruments have not sufficient resistance to compensate completely for temperature errors.

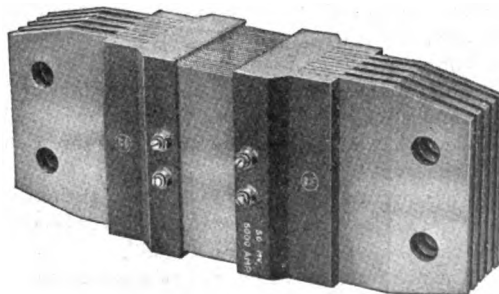
Style number and list price include shunt complete with instrument-lead connecting screws, but do not include leads or cable terminals. Shunt leads are furnished with all shunted-type ammeters.

### PRICES

Capacity Amperes	Style No.	List Price	Capacity Amperes	Style No.	List Price
10	289653	\$5 00	600	282641	\$ 9 00
15	289652	5 00	800	282642	12 50
25	289651	5 00	1000	282643	12 50
50	289650	5 00	1200	282644	14 00
75	289649	5 00	1500	282645	24 00
100	282634	5 00	2000	282646	30 00
150	282635	5 00	2500	282647	33 00
200	282636	5 50	3000	282648	37 00
250	282637	5 50	4000	282649	50 00
300	282638	5 50	5000	282650	75 00
400	282639	6 00	6000	282651	87 00
500	282640	7 50	8000	282652	125 00



1000 AMPERE TYPE G SHUNT



6000 AMPERE TYPE G SHUNT

## ALTERNATING-CURRENT SWITCHBOARD INSTRUMENTS

To develop a satisfactory line of alternating-current instruments, it is necessary, first, to determine their application by analyzing all human activities where alternating current measurements are required and, second, to determine the ideal

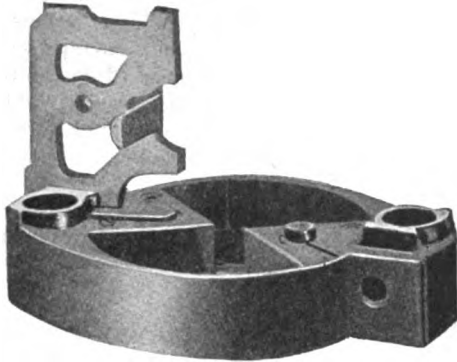


FIG. 1—MICARTA SUB-BASE WITH SUPPORTING BRACKET AND DAMPING CHAMBER OPEN

construction giving the widest application by analyzing all principles of instrument operation.

The Westinghouse engineers have been engaged in such an analysis for several years and the result has been the adoption of the dynamometer construction as being the most universal and ideal construction for alternating-current instruments.

Fundamentally, the dynamometer movement consists of two stationary coils which set up a field, and one or more moving coils, the current in which reacts with the stationary field to produce rotation.

The motion of the pointer can be damped in two ways. First, by means of a vane moving in an air tight chamber and second by a disk passing through the field of a permanent magnet. The air damper was adopted as being the superior.

The damping chamber is made from moulded composition which insulates the movement from the base and also insulates the metallic circuit formed by the supporting brackets and the bridge.

The supporting brackets are mounted on each end of the damping chamber and are clamped from opposite sides to assure centering. There are circular guides on these brackets for accurately locating the stationary coils. There are clamps for holding the coils on these guides.

The coils are oval giving maximum torque for minimum height. This allows the instrument to be made with a shallow case to match the direct-current instruments.

The current is conducted to and from the moving coil or coils by means of control springs or conducting strips.

The pointer is of the tapered tubing construction fully described under direct-current instruments.

The case is of soft iron, with that standard dull-black marine finish. The case may be easily removed without taking the instrument from the panel.

The cover is of flat glass, giving full opening for maximum lighting and legibility. There is an external zero adjustor.

Instruments are furnished rear connected.

The dials are metal with 100° scale angle, the same as the direct-current instruments. The scale distribution varies as the square of the voltage in the case of voltmeters. Ammeters have a slightly irregular scale distribution being fairly uniform above  $\frac{1}{2}$  scale. Wattmeters have nearly uniform scales slightly condensed at each end. Power factor meters and frequency meters have irregular scales.

The ammeter differs from the regular dynamometer instrument construction only in that one stationary coil is omitted and an iron vane is mounted on the shaft in place of the moving coil. This iron vane is pulled into the coil causing rotation. It was not until our Research Department developed a non-residual iron that we considered the moving iron principle as being satisfactory for high grade instruments.

These instruments can be used on direct current. By the correct proportioning of current values, all instruments except frequency meters, single-phase power factor meters, and synchronoscopes can be calibrated on direct current, thus doing away with the necessity of a transfer standard.

The type DY instruments,  $4\frac{3}{8}$  inches in diameter, match in size and appearance, with the d-c. type DX instruments. The DY instrument has a  $3\frac{1}{4}$ -inch scale and is for general switchboard applications where space is to be economized and accurate readings required.

The type SY instruments,  $7\frac{1}{2}$  inches in diameter match with the d-c. type SX instruments. Both types, DY and SY have the same size movement. The SY instrument has  $5\frac{1}{4}$ -inch scale and is for general switchboard application.

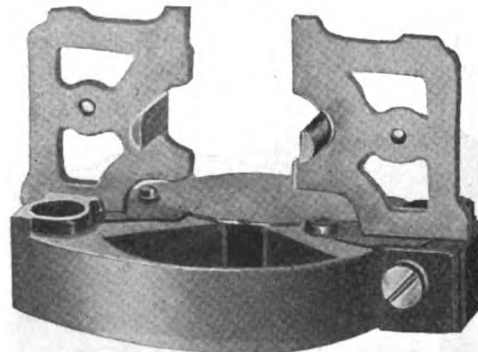
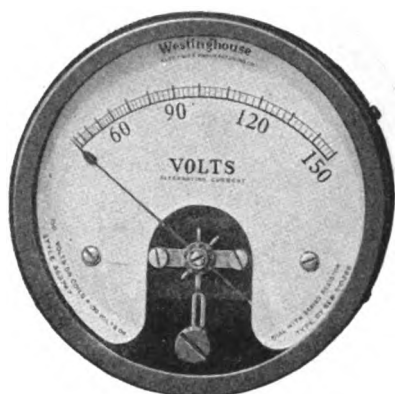


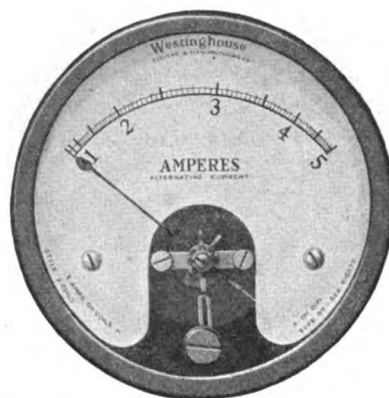
FIG. 2—MICARTA SUB-BASE WITH TWO SUPPORTING BRACKETS AND ONE-HALF OF DAMPING CHAMBER CLOSED

ALTERNATING-CURRENT SWITCHBOARD INSTRUMENTS—Continued

TYPES DY AND SY INSTRUMENTS



TYPE DY VOLTMETER



TYPE DY AMMETER

Special Applications

The single phase wattmeter can be furnished with dials to indicate "Cents-per-Hour" for use in displaying or demonstrating domestic electric devices such as irons, washers, fans, heaters, etc.

Wattmeters with dials marked in "Reactive Kv-a." can be furnished. Special external reactors with taps are required.

Instructions for Ordering

Order by style number when possible. Ammeters should be selected with full scale marking about 50 per cent in excess of full load of the circuit. For circuits of more than 10 amperes maximum current, or for circuits of any capacity at more than 600 volts, current transformers are required. The self contained instruments listed, are not insulated for more than 600 volts.

Voltmeters should be ordered with scale markings to suit voltage transformer ratios using uncalibrated style numbers. All voltmeters have external series resistors.

Wattmeters should be selected with full scale capacity 50 per cent in excess of full load of the circuit and with voltage rating within 25 per cent of the nominal voltage of the circuit to be measured.

For higher voltages, voltage transformers are necessary and should be ordered to suit the conditions. For currents of more than 10 amperes, or for circuits of any capacity at more than 600 volts, current transformers are required. All wattmeters have external series resistors for the voltage circuit. When an instrument is desired with full scale capacity differing from the product of primary current and voltage, the current rating of the instrument should correspond to the secondary current of the transformer at the desired full scale rating.

Power factor meters should be selected so that the maximum operating current will always be the same as the rating of the instrument. There are three external resistors for the voltage circuits of a three-phase meter and a combination resistor-reactor for the single-phase meter.

Frequency meters are for use on normally 110-volt circuits plus or minus 20 per cent. Other ranges supplied on special order.

Transformers should be ordered separately from the pages on "Current and Voltage Transformers." One current transformer is required for single-phase operation, two for two-phase and three-phase three-wire, and three for three-phase four-wire. One voltage transformer is required for single-phase operation and two for polyphase.

DY INSTRUMENTS

SY INSTRUMENTS

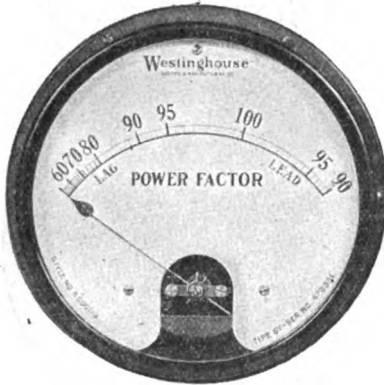
Ammeters

Calibrated for Use with Transformers

Capacity Amperes	STYLE Nos.		List Price	STYLE Nos.		List Price
	White Dial	Black Dial		White Dial	Black Dial	
5	363859	363876	\$24 00	363825	363842	\$30 00
10	363860	363877	24 00	363826	363843	30 00
15	363861	363878	24 00	363827	363844	30 00
25	363862	363879	24 00	363828	363845	30 00
50	363863	363880	24 00	363829	363846	30 00
75	363864	363881	24 00	363830	363847	30 00
100	363865	363882	24 00	363831	363848	30 00
150	363866	363883	24 00	363832	363849	30 00
200	363867	363884	24 00	363833	363850	30 00
300	363868	363885	24 00	363834	363851	30 00
400	363869	363886	24 00	363835	363852	30 00
500	363870	363887	24 00	363836	363853	30 00
750	363871	363888	24 00	363837	363854	30 00
1000	363872	363889	24 00	363838	363855	30 00
1500	363873	363890	24 00	363839	363856	30 00
2000	363874	363891	24 00	363840	363857	30 00
2500	363875	363892	24 00	363841	363858	30 00

(Table continued on following page)

ALTERNATING-CURRENT SWITCHBOARD INSTRUMENTS—Continued



TYPE SY POWER FACTOR METER



TYPE SY KILOWATT METER

BY INSTRUMENTS

SY INSTRUMENTS

Capacity Amperes	STYLE NOS.		List Price	STYLE NOS.		List Price
	White Dial	Black Dial		White Dial	Black Dial	
3.5-4.5	363732	363778	\$25 00	363640	363686	\$31 00
4.5-5.5	363733	363779	25 00	363641	363687	31 00
5.5-6.5	363734	363780	25 00	363642	363688	31 00
7-8	363735	363781	25 00	363643	363689	31 00
9-11	363736	363782	25 00	363644	363690	31 00

Self-Contained Ammeters for Use without Transformers

10	363737	363783	25 00	363645	363691	31 00
15	363738	363784	25 00	363646	363692	31 00
20	363739	363785	25 00	363647	363693	31 00
25	363740	363786	25 00	363648	363694	31 00

Voltmeters

Uncal. (150 V.coils)	363746	363792	27 00	363654	363700	35 00
150	363747	363793	27 00	363655	363701	35 00
300	363748	363794	32 00	363656	363702	40 00
600	363749	363795	37 00	363657	363703	45 00
750	363750	363796	42 00	363658	363704	50 00

Single-Phase Wattmeters

(Calibrated as Desired with Transformers)

Amps.	Volts	White Dial	Black Dial	List Price	White Dial	Black Dial	List Price
5	100	363751	363797	48 00	363659	363705	65 00
5	200	363752	363798	53 00	363660	363706	70 00
5	400	363753	363799	58 00	363661	363707	75 00
10	100	363754	363800	48 00	363662	363708	65 00
10	200	363755	363801	53 00	363663	363709	70 00
10	400	363756	363802	58 00	363664	363710	75 00

Uncalibrated Polyphase Wattmeters

(Calibrated as Desired with Transformers)

4	100	363757	363803	70 00	363665	363711	90 00
5	100	363758	363804	70 00	363666	363712	90 00
7.5	100	363759	363805	70 00	363667	363713	90 00
10	100	363760	363806	70 00	363668	363714	90 00
4	200	363761	363807	75 00	363669	363715	95 00
5	200	363762	363808	75 00	363670	363716	95 00
7.5	200	363763	363809	75 00	363671	363717	95 00
10	200	363764	363810	75 00	363672	363718	95 00
4	400	363765	363811	80 00	363673	363719	100 00
5	400	363766	363812	80 00	363674	363720	100 00
7.5	400	363767	363813	80 00	363675	363721	100 00
10	400	363768	363814	80 00	363676	363722	100 00
4	500	363769	363815	80 00	363677	363723	100 00
5	500	363770	363816	80 00	363678	363724	100 00
7.5	500	363771	363817	80 00	363679	363725	100 00
10	500	363772	363818	80 00	363680	363726	100 00

NOTE—The current ratings are plus or minus 10 per cent. The voltage ratings are plus or minus 20 per cent.

Power Factor Meters

Cycles	Volts	Scale	Single-Phase					
			White Dial	Black Dial	White Dial	Black Dial		
25	110	50-100-50	363773	363819	55 00	363681	363727	75 00
25	110	20-100-90	372235	372239	55 00	372243	372247	75 00
60	110	50-100-50	372236	372240	55 00	372244	372248	75 00
60	110	20-100-90	372237	372241	55 00	372245	372249	75 00
			Three-Phase, 3-Wire					
Any	110	50-100-50	363774	363826	55 00	363682	363728	75 00
Any	110	20-100-90	372238	372242	55 00	372246	372250	75 00

The scale is marked with lag at left and lead at right.

The single-phase meters should be used on a specific frequency and ordered accordingly.

For two-phase service use single phase instrument.

The 50-100-50 scale is for use with a-c. generators, synchronous motors, and feeders supplying principally synchronous motors.

The 20-100-90 scale is for use with compound wound synchronous converters and induction motor feeders.

Frequency Meters

25	110	363775	363821	60 00	363683	363729	80 00
60	110	363776	363822	60 00	363684	363730	80 00

## TYPE SI SWITCHBOARD SYNCHRONOSCOPE

### ALTERNATING-CURRENT—7 INCHES DIAMETER



#### Application

This instrument, by means of a pointer which assumes at every instant a position corresponding to the phase angle between the voltages of the bus-bars and the incoming machine, indicates the degree of synchronism. With this instrument exact indications can be obtained, which are a necessity in the paralleling of large generators and which are impossible with synchronizing lamps. The pointer is visible continuously during both the dark and the light periods of the synchronizing lamps.

In installations where a considerable distance separates the control board from the prime movers, it is good practice to provide an additional synchronoscope on the turbine gauge board for the guidance of the turbine operator.

#### Operation

A rotating field is produced by current from the bus-bars passing through a split-phase winding and two angularly placed coils. In this rotating field is a movable iron vane, or armature, magnetized by a stationary coil connected across the incoming machine. The iron vane takes a position where the zero of the rotating field occurs at the same instant as the zero of the stationary field. Thus its position at every instant indicates the phase angle between the voltage of the incoming machine and that of the bus-bars. As this angle changes, due to difference in frequency, the iron vane with the pointer attached to it rotates, and when synchronism is reached it remains stationary. This principle results in a greater reliability than is possible with moving coil devices, or synchronoscopes having collector rings or moving contacts.

#### Construction

Type SI synchronoscopes are of the same general appearance as the type SY instruments. The glass front allows the dial to be thoroughly illuminated and makes the entire pointer visible, so that the indications are clearly discernable at a considerable distance. All Westinghouse synchronoscopes are made single-phase.

**Finish**—Standard finish is dull black marine.

**Dimensions**—Overall diameter,  $7\frac{1}{8}$  inches; depth,  $2\frac{1}{2}$  inches.

**Approximate Weight**—11 pounds net, 25 pounds boxed.

**Transformers**—Westinghouse synchronoscopes are designed for circuits of 110 volts nominal and can be used on potentials up to 125 volts. For other voltages, transformers should be selected from pages on voltage transformers. These synchronoscopes take 10 watts per circuit and can be operated from the same transformers as other instruments. It is usual to install one transformer on each generator circuit with a six-point synchronizing plug and receptacle in the secondary circuit of each.

**Style number and list price** include single-phase synchronoscope complete, but without transformers or synchronizing plugs or receptacles.

Instruments to match with types SX and SY instruments.

Cycles	STYLE No.		List Price
	White Dial	Black Dial	
25	370900	370901	\$90 00
60	370902	370903	90 00

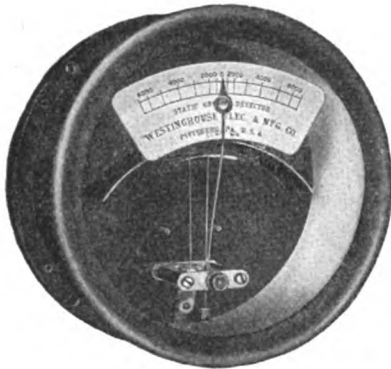
Instruments to match with types SM and SL instruments.

25	157244	.....	\$90 00
60	157245	.....	90 00

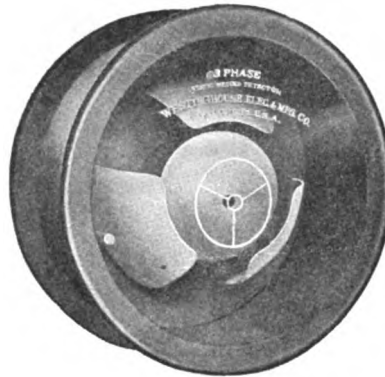
Order by Style Number

# TYPE TG SWITCHBOARD ELECTROSTATIC GROUND DETECTORS AND VOLTMETERS

## ALTERNATING-CURRENT—9 INCHES DIAMETER



SINGLE-PHASE GROUND DETECTOR



POLYPHASE GROUND DETECTOR

### TYPE TG ELECTROSTATIC GROUND DETECTORS

#### Application

Ground detectors are desirable on some alternating-current transmission or distributing systems to indicate a ground before it has developed to any serious extent. On a system in which one conductor might become grounded without tripping the circuit-breakers or a similar result, ground detectors are recommended. On high-voltage circuits no other than the electrostatic type of ground detector is practicable.

**Limitations**—The practical application of ground detectors is limited to overhead lines without a grounded neutral and on which the normal charging current passing into a ground is insufficient to trip a breaker, and to small underground systems.

#### Operation

The type TG ground detectors are connected to the circuit through condensers, so that the potential at the switchboard is low and safe.

The single-phase ground detector indicates a ground on either side of the system by the movement of a pointer. It is intended for use on single-phase system or in pairs on a two-phase system. Two single-phase instruments can be used on a three-phase system, and the grounded line determined by a comparison of the indications. The moving vane moves away from the fixed vane connected with the line on which a ground occurs.

The three-phase ground detector indicates a ground in any phase, and which phase is grounded. The movable-indicating vane moves away from the fixed vane connected with the grounded line.

#### Construction

The instruments are enclosed in metal cases with flat glass fronts.

**Finish**—Standard finish is dull black marine.

**Dimensions**—Overall diameter, 9 <sup>5</sup>/<sub>8</sub> inches; height on switchboard, 11 <sup>1</sup>/<sub>2</sub> inches including terminal post clearance; depth, 5 <sup>3</sup>/<sub>8</sub> inches.

**Approximate Weight**—12 pounds net, 32 pounds boxed.

**Style number and list price** include instrument complete with condensers as listed, ready to connect to the circuit.

Volts	No. of Condensers	Style No.	List Price
<b>Single-Phase</b>			
2200	2	15803	\$80 00
3500	2	183616	82 00
6600	2	15804	91 00
11000	2	15805	100 00
22000	2	15808	106 00
<b>Three-Phase</b>			
2200	3	35586	108 00
3500	3	183615	113 00
6600	3	35587	118 00
11000	3	35588	123 00
22000	3	35589	126 00

By means of special condensers these instruments can be adapted for higher voltages than listed. Prices on request.

Order by Style Number



TYPE TG A-C. ELECTROSTATIC GROUND DETECTORS AND VOLTMETERS—Continued

TYPE TG ELECTROSTATIC VOLTMETERS

Application

The electrostatic voltmeter is both a voltage indicator for single-phase high-voltage lines, and a ground detector. Its accuracy is insufficient for use as a voltmeter in the usual sense of the term; but for approximate voltage indications it is very serviceable.

one movable vane. The zero is at the left end of a scale graduated in volts. The stationary vane is connected to the line through a condenser, the movable vane and the case being grounded.

Style number and list price include instrument complete with condensers.

Construction

These instruments are similar to single-phase electrostatic ground detectors except that a single reading movement is used with one stationary and

Voltage To Ground	Full Scale Volts	Style No.	List Price
2200	3000	112882	\$65 00
6600	9000	112883	68 00
11000	15000	112884	75 00
22000	30000	112885	80 00

By means of special condensers these instruments can be adapted for higher voltages than listed. Prices on request.

CONDENSERS

The condenser consists of a brass tube covered with a layer of insulating material and a copper sheath. The inner tube is connected to the line and the outer sheath to a fixed vane of the ground detector. The condenser insulates the instrument from the line but the lead connecting the instrument and condensers must be treated as high-voltage conductors to avoid a disturbance of their electro-

static charge. They cannot be enclosed in metal conduits.

Volts	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
2200	5	11	29897	\$12 00
3500	5	11	163899	14 00
6600	5	11	29898	16 00
11000	5	11	29899	18 00
22000	5	11	29900	22 00

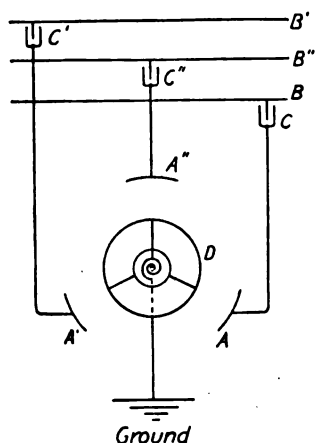


DIAGRAM AND CONNECTIONS OF THREE-PHASE GROUND DETECTOR

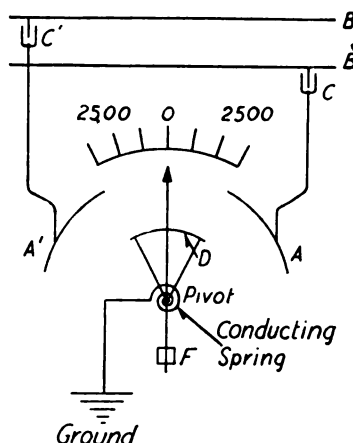


DIAGRAM AND CONNECTIONS OF SINGLE-PHASE GROUND DETECTOR

Order by Style Number

# TYPE SN ELECTROSTATIC GLOW METERS



3-PHASE GLOW METER

### Application

This is a vacuum-tube type of electrostatic potential indicator which may be used for indication of potential on the line, as a ground detector, or as an electrostatic synchronism indicator.

In high-tension switching stations it is often desirable to have an indication of the presence of potential, of a grounded phase, or of the condition of synchronism between two separate high-tension lines. Where no potential transformers are needed for other purposes, it becomes very expensive to provide the above indication. A simple device for securing these indications through the electrostatic discharge of one section of an insulator column has been developed thus obviating the necessity for potential transformers.

### Operation

When used as a ground detector or potential indicator the device is connected as shown in figure 1. It will be noticed that one bulb is in parallel with the bottom section of each of the three insulator columns.

When used for synchronizing between a bus and a line or between two lines or two busses the glow meter is connected as shown in figure 2. The phase connections through the top lamp are made such that the lamp will be out at synchronism. The phases to the two lower lamps are crossed so that

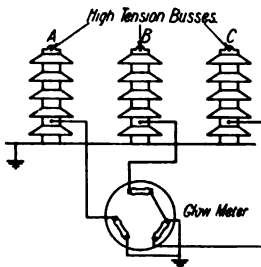


FIG. 1—CONNECTIONS FOR THE GLOW METER WHEN USED AS GROUND DETECTOR

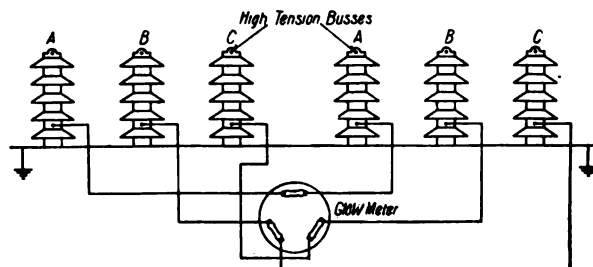


FIG. 2—THE GLOW METER USED AS A SYNCHRONOSCOPE

they will burn at half brilliancy at synchronism. When out of synchronism there will be an apparent rotation which will be an indication as to whether the incoming line is fast or slow.

For switching these instruments small type I oil switches are used, and it is possible to use one glow meter for a number of purposes by providing enough oil switches.

The connecting leads may be run considerable distances if carefully insulated and may be carried into buildings if treated as wiring for 2200 volts. The glow meter should preferably not be mounted on the switch board, but may be mounted above it on a bracket or on the wall or other suitable location.

All indications are that there is no limit to the useful life of the bulb.

### Construction

The base on which the apparatus is mounted is of micarta insulation. The indicating device consists of three small bulbs filled with neon which has the property of giving forth a vivid orange-red glow on an extremely small static discharge.

These bulbs are mounted between spring clips and are separated from one another by micarta tubing.

Style number and list price cover the instrument complete with case and three bulbs. For lower voltages than listed combinations with type TG condensers may be used. Prices upon application.

Style No.	Voltage	List Price
363946	6600 to 110,000	\$50 00

### Ground Detector

This 7-inch glow meter is designed only for use as a ground detector for 2400-volt, 3-phase lines, and not for use as a synchronizer. The connections to the line are through the action of condenser type bushings in the back of the case.

Style No.	Voltage	List Price
306240	2400	\$90 00
363212	Bulb for Glow Meter or Ground Detector	5 00

**Weights and dimensions**—The case is 7½ inches in diameter as in the SX and SY line of instrument. The net weight is approximately 10 pounds, shipping weight 30 pounds.

# TEMPERATURE INDICATORS

## SWITCHBOARD-MOUNTING

### Application

**Electrical Apparatus**—Many of the shutdowns on alternating-current generators are due to insulation breakdowns and examination of the insulation afterwards frequently shows that the failure has been caused by excessive temperature. Therefore, it is desirable, especially in large capacity generators, to know what are the maximum temperatures in the machine so that the load may be controlled in accordance with the safe temperature limits of the insulation.

Three general methods of temperature measurement may be used: by thermometer, by measuring increase in the resistance of the windings, and by embedded temperature detectors. With the first of these, surface temperatures of stationary parts only

can be observed. The second method gives only average temperatures of the winding and does not give temperatures of hot spots. It is therefore upon the third named method that the greatest dependence can be placed.

**Industrial Uses**—Embedded temperature detectors may be used in measuring the temperature of the interior of cotton or tobacco bales, storage coal piles, and similar places where excessive temperature may develop slow burning. However, in such applications it is often desirable to use a portable indicator—see "Portable Potentiometer" described and listed on another page.

These are two forms of embedded detectors for temperature measurement: exploring coils, and thermo-couples.

## OUTFITS FOR USE WITH EMBEDDED EXPLORING COILS

These give a direct and continuous indication of temperature. A separate source of direct current of constant voltage must be provided.

This method is limited to cases where convenience or direct and continuous indication of temperature are more important than high accuracy.

### Operation

The Wheatstone Bridge principle is used. The exploring coil is a resistor, the resistance of which varies with the temperature of the mass surrounding it, and forms the fourth arm of the bridge. The values of the other three resistances of the bridge are such that when the temperature of the exploring coil has reached some predetermined value the bridge is in balance and there is no difference in voltage between points 2 and 4 (Fig. 1). With the exploring coil at any other temperature, there will be a difference in voltage indicated on the voltmeter which is calibrated in degrees. The four arms of the bridge are made equal in resistance at the temperature for which greatest accuracy is desired; and at this temperature, which is called the balance temperature, the indications will be independent of applied control-circuit voltage. This point will be marked by a red scale line. Standard balance point temperatures and scale ranges are indicated below.

### Construction

The exploring coil is made up of a large number of turns of copper wire wound on a strip of mica. The

finished coil is about 5 inches long and  $\frac{1}{8}$  inch thick and at normal temperature has a resistance of approximately 10 ohms.

**Resistors**—The bridge resistors are generally mounted in a bridge box back of the switchboard panel.

**Impressed Voltage**—This equipment is calibrated for use with standard d-c. control voltages as listed below. The source of control voltage must be kept fairly constant in value, as at scale points remote from the balance temperature, the error of indication, due to variations from normal control voltage, is increased.

**Leads**—It is recommended that leads of not smaller than No. 8 copper wire, and of a resistance not exceeding 2 ohms total, be used between the bridge box and exploring coils. Although the resistance of leads is automatically balanced when properly connected, this resistance should be kept at as low a value as possible.

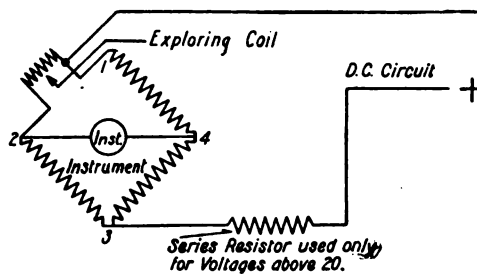


FIG. 1—DIAGRAM OF CONNECTIONS

TEMPERATURE INDICATORS—Continued



TYPE SX TEMPERATURE INDICATOR

Style number and list price include the outfit complete with bridge box and instrument calibrated for the scale range, control voltage, and balance temperature, as listed below. A series resistor is required for control voltage above 125 volts, and is included in the style number and price, as listed. The style number does not include the exploring coils or connecting leads. It is calibrated for use with standard Westinghouse 10-ohm exploring coils. Exploring coils of different forms are designed to suit the machine or apparatus in which they are to be used. If it is desired to use this type of equipment with exploring coils of other resistances or makes, or for a control voltage, scale range or balance temperature other than those listed, this can be secured at an increased price on application.

TEMPERATURE INDICATORS

For Use with 10-Ohm Exploring Coils

Scale	Balance Temperature	Volts Control	TYPE SX		TYPE DX	
			Style No.	List Price	Style No.	List Price
0-100°C	80°C	20	304679	\$60 00	304688	\$45 00
0-100°C	80°C	125	304680	80 00	304689	45 00
0-100°C	80°C	250	304681	80 00	304690	45 00
0-150°C	100°C	20	304682	80 00	304691	45 00
0-150°C	100°C	125	304683	80 00	304692	45 00
0-150°C	100°C	250	304684	80 00	304693	45 00
0-200°C	150°C	20	304685	80 00	304694	45 00
0-200°C	150°C	125	304686	80 00	304695	45 00
0-200°C	150°C	250	304687	80 00	304696	45 00

OUTFITS FOR USE WITH EMBEDDED THERMO-COUPLES

**Distinctive Features**—This method balances the e. m. f. of the test couple against that of another couple at known temperature; it thus avoids all errors due to variation in leads, etc., and as it indicates on the "null" or zero-reading principle, very accurate readings can be obtained. Danger of short circuit or open circuit when placed in machine is a minimum. Ease of calibration and checking. Battery voltage need not be constant.

inch thick, .25 inch wide and of any desired length. The couple is insulated with mica and micarta paper to withstand a temperature of at least 150 degrees Centigrade. An inherent characteristic of this couple is that its difference in potential is 42 micro-volts per degree centigrade difference between

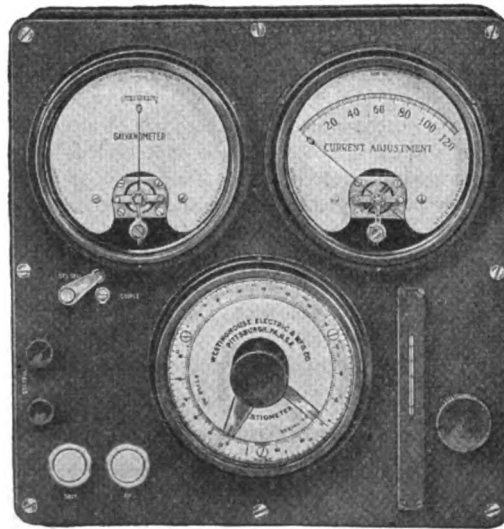
Operation

One thermo-couple is embedded in the mass of which the temperature is to be measured and the other, the "cold" couple, located where its temperature can be easily recorded on a thermometer. An instrument can then be so connected that it will show the difference in voltage between the two couples and therefore the temperature can be easily determined.

In the Westinghouse outfit the instrument is calibrated to read directly the temperature of the test couple.

Construction

Westinghouse thermo-couples are made by welding copper and "advance" (nickel-copper) alloy ribbons together. These ribbons are ordinarily .005



TYPE DT TEMPERATURE INDICATOR

## TEMPERATURE INDICATORS—Continued

the two couples. Its use is therefore inherently accurate and dependable under all conditions.

The Westinghouse type DT temperature indicator combines in one case all necessary parts except the test couple. It operates on the "potentiometer principle."

The instrument case contains the "cold" couple which is in contact with the bulb of a mercury thermometer, by which the temperature of the cold couple is observed.

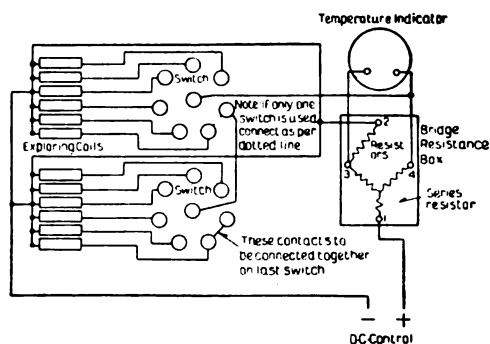


DIAGRAM OF CONNECTIONS FOR HOT-SPOT MEASUREMENT

A dry cell supplies current to a resistance wire equipped with two sliding contacts. The drop of potential between these contacts is proportional to the current in the wire and to the distance between them. Two pointers which move with the contacts indicate the positions of the two contacts. The scale is calibrated in millivolts and degrees; divisions on the millivolt scale are of equal width, divisions on the temperature scale are spaced according to the e. m. f. law of the couple. A rheostat in the battery circuit is used for adjusting the current exactly to the value that will cause a drop of e. m. f. per degree on the temperature scale equal to the thermo e. m. f. per degree in the couple. Leads from the thermo-couple connect through a sensitive galvanometer to the slide wire contacts of corresponding polarity. If the e. m. f. between the contacts is equal to the thermo e. m. f., there will be no deflection of the galvanometer. If higher or lower, there will be a deflection of the galvanometer in one or the other direction. By changing the distance between

contacts, using the galvanometer as a guide, the position at which the slide e. m. f. balances the thermo e. m. f. is easily located.

In practice, the lower pointer is set at the position on the scale corresponding with the temperature of the cold couple and the upper pointer is moved until a balance is obtained as described. Actual temperature of hot couple can then be read directly on the scale.

**Case**—The type DT temperature indicator is mounted in a black finished metal case arranged for rear connection mounting direct upon a switchboard panel. Size of case: 11 inches wide by 11 inches high; extends  $4\frac{3}{4}$  inches from switchboard. The dry cell for operation is to be mounted at the back of the switchboard directly behind the indicator.

**Wiring**—All wiring from the test couple to the indicator must consist of one copper wire and one advance alloy wire.

In ordinary practice, individual copper wire leads are used to connect each individual couple through a dial switch (see following) on the switchboard to the instrument and a common advance alloy lead connects all the couples to the instrument. This side of the circuit is usually grounded in order that no voltage may be carried to the switchboard by failure of the armature coil insulation to the couple, which would allow generator potential on the circuit; also in order that any static disturbance may not affect the accuracy of the instrument. Connecting leads listed can be used up to distances of 300 feet. Cases requiring greater length of lead should be a subject of special negotiation.

**Style number and list price include switchboard mounting instrument complete with one test couple.**

Description	Temperature Range	Milli-volt Range	Style No.	List Price
Type DT Temperature Indicator	0-200	0-8.4	306279	\$200 00
Two-Conductor Connecting Leads (one copper and one advance alloy), per foot				25
Seven-Conductor Connecting Leads (six copper and one advance alloy), per foot				85

**Approximate weight of indicator:** net, 9 pounds; boxed, 20 pounds.

## DIAL SWITCH

It is usual to install six thermo-couples in each generator. The leads from these are then brought out to a terminal board on the generator and from there to the switchboard. By installing a dial switch on the switchboard, connection can be made readily from the instrument to any one of the couples.

The dial switch here listed has seven points. Six of these points can be connected to thermo-couple leads and the seventh to a similar dial switch, one

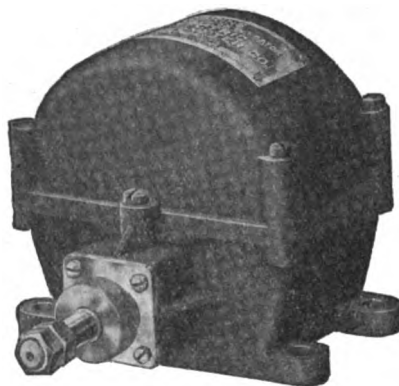
being required for each generator. Thus, any number of thermo-couples of one machine or of several can be read at will with one instrument.

**Style number and list price include dial switch as described.**

Amperes Capacity	Maximum Volts	Style No.	List Price
30	250	273175	\$7 00

Order by Style Number

## ELECTRICAL SPEED INDICATORS



MAGNETO GENERATOR

### Application

Electrical speed indicators are used for indicating the speed of rotating machinery, where the location of the indicator prevents the use of mechanically driven indicators or so-called speedometers. Calibration may be made in revolutions per minute, feet per minute, cycles per second, percentage fast or slow, copies per minute on newspaper presses, or in general wherever quantity indicated is a function of the speed.

When applied in railway service the magneto, if mounted on car trucks, must be protected from excessive vibration by some form of spring suspension to be devised by the purchaser. For operation on cars it is usual to belt the magneto pulley to the car axle.

### Operation and Construction

The speed indicator consists of a magneto generator and a direct-current instrument. The magneto is belted to a pulley or shaft of the apparatus of which the speed is desired. The voltage of the magneto is proportional to its speed so that it is possible to calibrate the instrument to indicate the speed directly in any unit required. The instrument can be mounted away from the magneto.

The magneto operates normally at 1500 revolutions per minute and pulley ratio should be selected accordingly; when necessary the speed producing full scale reading on the instrument can vary between 1000 and 1500 rpm. The magneto generator is arranged for mounting with base either vertical or horizontal on wall, floor or ceiling.

No provision is made for mounting the magneto other than the holes in the base. The local conditions of installation vary so widely that it is best to have this taken care of at the time of installation. Outlines of the magnetos and pulleys will be furnished upon application. The mounting should be such as to allow proper space for pulleys and belt. Magnetos must not be mounted direct upon iron parts since they would weaken the effect of the permanent magnets.

**Overall dimensions**—Magneto base  $6\frac{1}{8}$  inches wide, shaft length  $8\frac{3}{4}$  inches, height  $5\frac{5}{8}$  inches, center line of shaft  $1\frac{3}{8}$  inches above bottom of base.

The indicator may be any of the X line of D'Arsonval voltmeters such as type BX, DX, PX, SX, or a type R d-c recording ammeter wound for use as a voltmeter. Add \$2.50 to the list price of the standard instrument for calibration as speed indicator.

## ELECTRICAL SPEED INDICATORS—Continued

## MAGNETO GENERATORS

Style number and list price include magneto only without pulley or instrument.

Description	APPROXIMATE WEIGHT, POUNDS		Style Number	List Price
	Net	Shipping		
Magneto	13½	18	289368	\$150 00

## MAGNETO PULLEYS

The magnetos are generally arranged to be driven by belts. The following standard pulleys are suitable for use with flat belt ⅝-inch wide. Special pulleys can be supplied if necessary, but with the range of operating speed of the magneto it is usually practicable to select a driving pulley, which in

connection with one of the magneto pulleys listed, will give a satisfactory pulley ratio. Driving pulleys are essentially part of the machinery the speed of which is to be measured, and therefore on account of variation in requirements of mounting applications can best be made locally by the user.

Diameter Inches	Description	Approx. Net Wt., Lbs.	Style Number	List Price
2	Pulley for magneto	1	289889	\$4 00
2½	Pulley for magneto	1	289890	4 50
3	Pulley for magneto	2	289891	5 00
4	Pulley for magneto	2	289892	6 00

## BELTS

The following endless rubber belts are recommended:

Description	Style Number	List Price
½x½-inch rubber belt, 24 inches circumference	289893	\$1 25
½x½-inch rubber belt, 26 inches circumference	289894	1 50
½x½-inch rubber belt, 37 inches circumference	289895	2 00

## INSTRUMENTS

Description	STYLE No.		List Price
	White Dial	Black Dial	
Type BX Flush	305914	305908	\$10 00
Type BX Projection	308306	308307	10 00
Type CX Flush	372399	372400	11 00
Type CX Projection	372401	372402	11 00
Type DX Projection	305906	319105	18 00
Type SX Projection	305910	305912	35 00

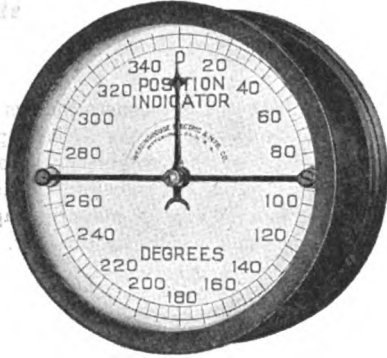
## INFORMATION FOR ORDERING

When entering order specify the following:

- (A) Type of instrument required as a separate item, giving scale markings.  
 (B) Style of magneto.  
 (C) Resistance or length and section of connecting wire to be used.  
 (D) Diameter of driving shaft if belt is direct on shaft, or diameter of driving pulley.  
 (E) Magneto pulley.  
 (F) Belt.

*Order by Style Number*

## TYPE SI POSITION INDICATOR AND CONTROLLER



### Application

Position indicators and transmitters may be used for signaling. Water level indicators may be made by attaching a float to a cable, which passes over a pulley. This pulley being attached to the transmitter, the motion of the cable is passed to the transmitter. The rising or falling of the float will cause the transmitter to turn and hence the pointer on the indicator. By gearing the transmitter to a lift bridge or railroad turn table their position may be indicated accurately at the point of control. The percentage opening of water wheel gates or steam throttles may be indicated at various points. Location of elevators may be shown.

### Principle of Operation

If an induction motor has single-phase rotor winding and a three-phase stator winding or the converse and the rotor is excited from an alternating-current source, any motion of the rotor will cause a variation in the currents in the three phases of the stator as induced by transformer actions. By winding a type SI power factor meter for low current and exciting the rotating element from the same source as the induction motor rotor, or a source in phase with it, and by connecting the three phases of the motor stator to the three distributed windings in the type SI power factor meter, any motion of the motor rotor will cause a similar motion of the meter pointer.

The above has been utilized to produce a position indicator and transmitter.

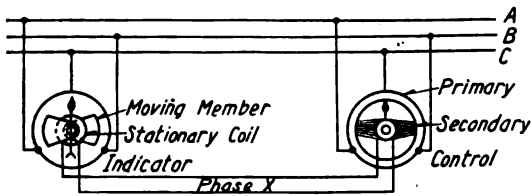


FIG. 1—THREE-PHASE SUPPLY, SINGLE-PHASE CONTROL

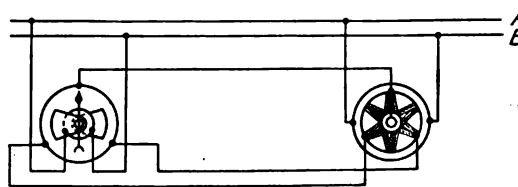


FIG. 2—SINGLE-PHASE SUPPLY, THREE-WIRE CONTROL

**Control—110-volts; 60 cycles, single-phase or three-phase**

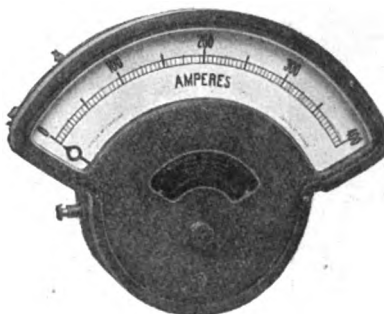
Indicator with dial marked in degrees .....	Style No.	List Price
Controller, single or three-phase .....	311819	\$75 00
	310206	55 00

*Order by Style Number*



# TYPES GL AND GM SWITCHBOARD AMMETERS AND VOLTMETERS

## ILLUMINATED DIALS



TYPE GL D-C. AMMETER

### Operation and Construction

The type GL direct-current instruments operate, on the D'Arsonval principle and type GM alternating-current instruments on the induction principle.

**Scales** are  $1\frac{1}{4}$  inches long, and are made of translucent material, illuminated from the rear by two 110-volt 6-candle-power tubular lamps.

**Finish**—Standard finish is dull black marine.

**Connections**—The instruments are front connected.

**Dimensions**—Overall height,  $12\frac{1}{8}$  inches; overall width,  $15\frac{3}{4}$  inches; depth, 3 to  $3\frac{1}{2}$  inches; mounting screws suitable for switchboards up to 2 inches thick.

**Approximate Weight**—21 pounds net, 50 pounds boxed.

### Type GL D-C. Ammeters

**Ammeters**—Shunt leads are furnished with the ammeters but shunts should be ordered separately from pages on "Ammeter Shunts." The ammeters give full deflection with 50-millivolt shunts.

**Style number and list price** include instrument with lamps and shunt leads, calibrated with the shunt ordered.

Description	Style No.	List Price
Ammeter without shunt, scale and calibration as desired	162320	\$123 00
Uncalibrated ammeter without shunt for special magnetic field conditions	246343	130 00

### Type GL D-C. Voltmeters

The differential voltmeter and the type GL voltmeter above 300 volts require external resistors. All other voltmeters are self-contained.

**Differential voltmeters** have the zero in the center of the scale and read zero when two equal voltages of the same polarity are applied.

**Ground detector voltmeters** and double-reading instruments are furnished on special order.

**Style number and list price** include voltmeter complete.

Volts	VOLTMETER		DIFFERENTIAL VOLTMETER	
	Style No.	List Price	Style No.	List Price
150	162322	\$129 00	162326	\$135 00
300	162323	132 00	162327	138 00
600	162324	135 00	162328	141 00
750	162325	138 00	162329	144 00

### Type GM A-C. Ammeters

**Style number and list price** include instrument calibrated as desired. Transformers should be ordered to suit conditions, with 5-amperes secondary current at full scale deflection.

Frequency	Style No.	List Price
25 Cycles	166778	\$125 00
60 Cycles	166779	125 00

### Type GM A-C. Voltmeters

**Style number and list price** include instrument complete with resistor.

The instrument will be calibrated to order. When desired for circuits of higher voltage or of other frequency than listed, suitable voltage transformers must be used. The secondary of the transformer should be 100 volts at nominal voltage and the scale 50 per cent greater than nominal voltage of the circuit.

Volts	STYLE No.		List Price
	25 Cycles	60 Cycles	
150	166770	166774	\$125 00
300	166771	166775	130 00
600	166772	166776	135 00
750	166773	166777	140 00

Uncalibrated, any frequency, Style No. 166769, list price \$125.00.

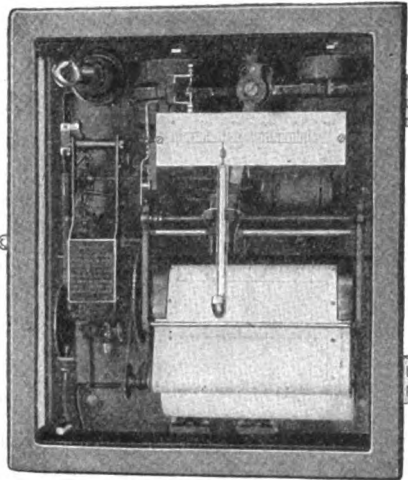
### Frosted Tubular Carbon Lamps

Volts	Watts	Base	Style No.	List Price
110*	30	Edison	99895	On Request

\*For 220-volt circuits, reconnect sockets in series. For higher voltages, additional 30-watt carbon lamps can be connected in series on back of switchboard.

Order by Style Number

## TYPE R SWITCHBOARD RECORDING INSTRUMENTS



TYPE R WATTMETER

### Application

These instruments are suitable for applications where accuracy and sensitiveness to small changes, in the quantity measured, is desired. They are used extensively for making records of the electrical quantities involved in power house and substation operation. The load curve recorded by these instruments is used by central station companies for determining the power demands of large power consumers.

Rear connected instruments are made for switchboard mounting. Front connected instruments are suitable for either switchboard or wall mounting as no studs project from the back. The drilling of the front-connected meter is similar to that of the solenoid-operated meters.

All instruments have indicating dials, rendering the use of separate indicating instruments unnecessary, thus resulting in a distinct saving in certain installation.

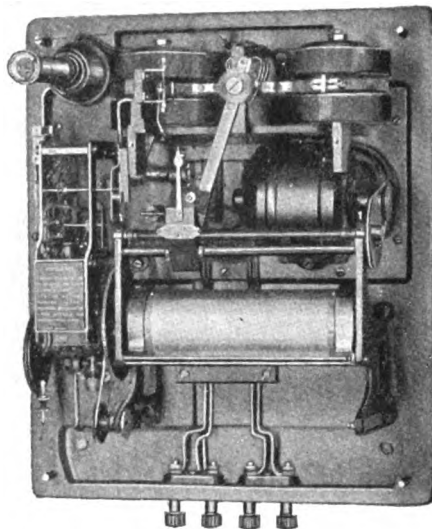
### Operation

All instruments operate on the relay principle, the measuring element actuating only contacts and not moving the pen directly. In turn, these contacts energize a device arranged to move the pen. The use of resistances prevents harmful sparking at the contacts, which are made of special alloy.

### Details and Construction

The power required for the measuring element is not greater than that for Westinghouse indicating instruments.

The control circuit is generally 110 volts, direct-current, 25 or 60 cycles alternating-current, the allowable temporary variation of voltage being that ordinarily found in practice, but instruments for other control circuits can be supplied on special



TYPE R VOLTMETER, COVER REMOVED

order. However, when the direct-current supply is from an exciter circuit controlled by an automatic voltage regulator, causing great fluctuations, alternating-current control should be used.

The record is made by a pen moving in a straight horizontal line at right angles to the motion of the paper, giving a scale having rectangular coordinates.

The pen is self-feeding and will hold one month's supply of ink. The feed is uniform at all temperatures. The marking point is a hard-alloy tube which will not clog, or scratch the paper. A rubber bulb and tube filler is supplied with each instrument.

The motion of the pen and consequently the sensitiveness of the instrument may be regulated by varying the distance between the contacts. This varies the amount the quantity measured must change, before the recording mechanism is affected by the closing of the contacts.

The record paper is supplied in a long roll providing continuous records for any desired period. It is legibly printed in black and is inexpensive. The width is approximately  $6\frac{3}{4}$  inches, the scale being  $5\frac{1}{4}$  inches. Rolls having a speed of 2 inches per hour contain sufficient paper for two months service. The standard paper speeds are 2, 4 or 8 inches per hour. Paper for 24 inches per hour can be furnished on application. Each motor-operated instrument has a paper collecting roll of 124 feet capacity; and each solenoid-operated, 32 feet.

The clock, which turns the paper rolls, is of the electric self-winding type and operates from the control circuit at the end of each 2-inch period. It will run for an extra winding period if the control circuit should be open.

If an instrument is desired the speed of which can be adjusted from 8 to 4 or 2 inches per hour, the fact

## TYPE R SWITCHBOARD RECORDING INSTRUMENTS—Continued

should be stated in the order and a clock suitable for this purpose will be provided with extra sets of gears at an increase in price.

Unless otherwise specified, clock and paper suited to a speed of 2 inches per hour are furnished. This clock is not suitable for operation at higher speed.

**Pen-Operating Mechanism**—In direct-current wattmeters and in power-factor meters, the pen is operated by solenoids energized through the relay contacts. In alternating-current—direct-current voltmeters, alternating-current ammeters, direct-current ammeters, alternating-current wattmeters, and frequency meters, the pen is operated by a small motor similarly energized through the relay contacts.

**The ink** furnished with the instruments is of special grade. It is furnished in concentrated form to be added to distilled water, making a writing fluid containing a minimum of solid matter. The ordinary commercial writing inks are not recommended as they cause the pen point to clog.

**Mechanical Construction**—The construction is strong and compact, no delicate parts being used.

The connection between the pen carriage and the meter is made by a single arm and a spiral spring, eliminating all lost motion, so that every movement of the pen carriage affects the meter element. The pen carriage is so guided that the pen, at all times, is perpendicular to the operating worm.

All instruments are designed for switchboard mounting, or wall, and are enclosed in glass cases with hinged glass front.

**Case**—Motor-operated instruments are either front or rear-connected. All solenoid-operated instruments are front-connected and have metal frame glass cover with hinged glass door. Types can be furnished with front connections and with hinged glass door.

### Measuring Elements

The measuring elements of **alternating-current and direct-current voltmeters, alternating-current ammeters and alternating-current and direct-current wattmeters** are of the Kelvin-balance type similar to Westinghouse precision instruments. They are independent of variations in frequency, external fields, temperature, power factor, or wave form. **Polyphase wattmeters** are correct with any degree of unbalancing of phases. **Direct-current ammeters** are of the permanent magnet type with moving coils, and operate from shunts.

**Direct-current wattmeters** are similar to the alternating-current wattmeters except that the series

coils are designed to carry the total current. These instruments obviate the usual difficulties of direct-current switchboard wattmeters, such as: The inconvenience of installing due to heavy currents; the great difficulty of recalibration; the amount of labor involved in removing the instrument when repairs become necessary; the consequent necessity of interrupting the circuit.

The heavy capacity wattmeters have a construction that permits removing the instrument proper from the circuit for repairs, recalibration, etc., leaving the series coil in place upon the switchboard. The measuring element complete, with clock, voltage coil, pen and paper mechanism is mounted upon a separate base, hung from the series coil. A record of the calibration and strength of the magnetic field produced by the series coil is kept at the Works, so that for repair or recalibration, the measuring element only, without the series coil or case, may be returned.

### Dimensions and Weights

The approximate dimensions of all except direct-current wattmeters are: overall width  $13\frac{1}{4}$  inches, overall length  $16\frac{1}{2}$  inches, overall depth  $9\frac{5}{8}$  inches. Outlines of direct-current wattmeters furnished upon application.

Net weight of one instrument, 35 pounds. Boxed weight of one instrument, 170 pounds.

**The style number and list price** include instrument with one roll of standard paper, two pens, one filler, one bottle of ink, and one indicating dial and pointer, but without shunts or transformers. Ammeter shunts for direct-current ammeters, or current and voltage transformers for alternating-current instruments, and paper of the proper marking, enable any capacity to be obtained.

**Shunts** listed on pages on "Direct-Current Ammeter Shunts," are suitable for the direct-current graphic ammeters. One shunt will operate both an indicating and a graphic instrument without error. Shunt leads 8 feet in length are regularly supplied with each direct-current ammeter.

**Voltage transformers** should have a secondary voltage of 100 volts at the nominal voltage of the circuit.

**Current transformers** should have a secondary current of five amperes at the maximum reading of the instrument.

For further information on voltage and current transformers, see pages on "Current Transformers" and "Voltage Transformers."

## A-C. TYPE R RECORDING AMMETERS

These instruments have a nominal capacity of 5 amperes and may be used on any frequency, or on a direct-current circuit not exceeding 5 amperes, but cannot be operated from a shunt for higher

direct-current ranges. For higher alternating-current ranges, instrument should be operated with a current transformer. The 5-ampere full-scale calibration may be varied from 4 amperes to 7.5 amperes

TYPE R SWITCHBOARD RECORDING INSTRUMENTS—Continued

if required to suit current transformer capacities. Orders should specify full scale rating desired,

according to paper capacity selected, and the ratio of current transformers.

Capacity Inst. Circuit Amperes	Control Circuit	Style No. Rear Connected	Style No. Front Connected	List Price
5	110-volts, d-c.....	374798	372581	\$200 00
5	110-volts, 25 Cycles.....	374799	372582	200 00
5	110-volts, 60 Cycles.....	374800	372583	200 00
5	250-volts, d-c.....	374801	372584	200 00

A-C. OR D-C. TYPE R RECORDING VOLTMETERS

Correct at any frequency. For higher alternating-current voltages than those listed, the 90-140-volt range should be selected and operated from a voltage transformer.

paper listed. This paper is marked "Recording Meter" and is thus suitable for use with voltmeters as well as alternating-current ammeters.

Voltmeters may be calibrated with chart starting from zero if desired, using any standard ammeter

Orders should specify the full scale rating desired, according to paper capacity selected, and the ratio of voltage transformers.

Capacity Inst. Circuit Amperes	Control Circuit	Style No. Rear Connected	Style No. Front Connected	List Price
90-140	110-volts, d-c.....	374802	372585	\$230 00
90-140	110-volts, 25 Cycles.....	374803	372586	230 00
90-140	110-volts, 60 Cycles.....	374804	372587	230 00
90-140	250-volts, d-c.....	374805	372588	235 00
180-280	110-volts, d-c.....	374806	372589	240 00
180-280	110-volts, 25 Cycles.....	374807	372590	240 00
180-280	110-volts, 60 Cycles.....	374808	372591	240 00
180-280	250-volts, d-c.....	374809	372592	240 00
250-450	110-volts, d-c.....	374810	372593	240 00
250-450	110-volts, 25 Cycles.....	374811	372594	240 00
250-450	110-volts, 60 Cycles.....	374812	372595	240 00
250-450	250-volts, d-c.....	374813	372596	245 00
360-560	110-volts, d-c.....	374814	372597	250 00
360-560	110-volts, 25 Cycles.....	374815	372598	250 00
360-560	110-volts, 60 Cycles.....	374816	372599	250 00
360-560	250-volts, d-c.....	374817	372600	255 00
450-700	110-volts, d-c.....	374818	372601	255 00
450-700	110-volts, 25 Cycles.....	374819	372602	255 00
450-700	110-volts, 60 Cycles.....	374820	372603	255 00
450-700	250-volts, d-c.....	374821	372604	260 00

SINGLE AND POLYPHASE TYPE R RECORDING WATTMETERS

The instruments listed have a nominal capacity of 5 amperes and may be used on any frequency, or on a direct-current circuit not exceeding 5 amperes, but cannot be operated from a shunt for higher direct-current ranges. For higher alternating-current ranges the instruments should be operated in connection with current transformers. The 5-ampere full-scale rating may be varied from 4 amperes to 7.5 amperes to suit current transformers and scale required. For single-phase, one current transformer is required. For three-wire three-phase, or for two-phase two current transformers are re-

quired. For three-phase four-wire, or three-phase six-wire, three current transformers are required. For higher voltages than listed, the 110-volt instruments should be operated with voltage transformers, one being required for single-phase, and two for polyphase.

Reactive component recording wattmeters can be furnished similar to the arrangement of the type SM.

Orders should specify the full scale rating desired, according to paper capacity selected, and the ratios of current and voltage transformers.

CAPACITY INST. CIRCUIT Amperes	Volts	Control Circuit	Style No. Rear Connected	Style No. Front Connected	List Price
<b>Single-Phase Wattmeter</b>					
5	100	110-volts, d-c.....	374822	372605	\$200 00
5	100	110-volts, 25 Cycles.....	374823	372606	200 00
5	100	110-volts, 60 Cycles.....	374824	372607	200 00
5	100	250-volts, d-c.....	374825	372608	205 00
5	200	110-volts, d-c.....	374826	372609	210 00
5	200	110-volts, 25 Cycles.....	374827	372610	210 00
5	200	110-volts, 60 Cycles.....	374828	372611	210 00
5	200	250-volts, d-c.....	374829	372612	215 00
5	400	110-volts, d-c.....	374830	372613	215 00
5	400	110-volts, 25 Cycles.....	374831	372614	215 00
5	400	110-volts, 60 Cycles.....	374832	372615	215 00
5	400	250-volts, d-c.....	374833	372616	220 00
<b>Polyphase Wattmeters</b>					
5	100	110-volts, d-c.....	374834	372617	200 00
5	100	110-volts, 25 Cycles.....	374835	372618	200 00
5	100	110-volts, 60 Cycles.....	374836	372619	200 00
5	100	250-volts, d-c.....	374837	372620	205 00
5	200	110-volts, d-c.....	374838	372621	210 00
5	200	110-volts, 25 Cycles.....	374839	372622	210 00
5	200	110-volts, 60 Cycles.....	374840	372623	210 00
5	200	250-volts, d-c.....	374841	372624	215 00
5	400	110-volts, d-c.....	374842	372625	215 00
5	400	110-volts, 25 Cycles.....	374843	372626	215 00
5	400	110-volts, 60 Cycles.....	374844	372627	215 00
5	400	250-volts, d-c.....	374845	372628	220 00

Order by Style Number

TYPE R SWITCHBOARD RECORDING INSTRUMENTS—Continued

D-C. RECORDING WATTMETERS

The paper used is the same as that for alternating-current wattmeters. If the normal voltage multiplied by the desired maximum current rating differs from any listed kilowatt paper capacity, use the nearest capacity paper listed, as the calibration will be made to suit the paper.

Five and Ten-Ampere Capacities—For 5 amperes

direct-current use the 5-ampere alternating-current wattmeter calibrated on direct-current; and for 10 amperes use the same instrument with series coils in multiple. Prices for either capacity will be the same as for the alternating-current wattmeter.

An external resistor is furnished for each voltage circuit.

METER CAPACITY Amperes	Volts†	Paper Capacity.* Kilowatts	Style No.	List Price
<b>Two-Wire</b>				
25	100-125	2.4	107150	\$370 00
25	200-250	5	107151	380 00
25	500-650	12	107152	390 00
50	100-125	5	107153	375 00
50	200-250	10	107154	385 00
50	500-650	25	107155	395 00
100	100-125	10	107156	375 00
100	200-250	20	107157	385 00
100	500-650	50	107158	395 00
200	100-125	20	107159	380 00
200	200-250	40	107160	390 00
200	500-650	100	107161	400 00
400	100-125	40	107162	390 00
400	200-250	80	107163	400 00
400	500-650	200	107164	410 00
600	100-125	60	107165	400 00
600	200-250	120	107166	410 00
600	500-650	300	107167	420 00
800	100-125	80	107168	410 00
800	200-250	160	107169	420 00
800	500-650	400	107170	430 00
1000	100-125	100	107171	420 00
1000	200-250	200	107172	430 00
1000	500-650	500	107173	440 00
1600	100-125	160	107174	445 00
1600	200-250	320	107175	455 00
1600	500-650	800	107176	465 00
2000	100-125	200	107177	460 00
2000	200-250	400	107178	470 00
2000	500-650	1000	107179	480 00
2500	100-125	240	107180	480 00
2500	200-250	500	107181	490 00
2500	500-650	1200	107182	500 00
3000	100-125	300	107183	500 00
3000	200-250	600	107184	510 00
3000	500-650	1600	107185	520 00
4000	100-125	400	107186	535 00
4000	200-250	800	107187	545 00
4000	500-650	2000	107188	555 00

METER CAPACITY Amperes	Volts†	Paper Capacity.* Kilowatts	Style No.	List Price
5000	100-125	500	107189	\$565 00
5000	200-250	1000	107190	575 00
5000	500-650	2400	107191	585 00
6000	100-125	600	107192	595 00
6000	200-250	1200	107193	605 00
6000	500-650	3000	107194	615 00
8000	100-125	800	107195	635 00
8000	200-250	1600	107196	645 00
8000	500-650	4000	107197	655 00
10000	100-125	1000	107198	675 00
10000	200-250	2000	107199	685 00
10000	500-650	5000	107200	695 00
16000	100-125	1600	107201	765 00
16000	200-250	3200	107202	775 00
16000	500-650	8000	107203	785 00
20000	100-125	2000	107204	805 00
20000	200-250	4000	107205	815 00
20000	500-650	10000	107206	825 00
25000	100-125	2400	107207	855 00
25000	200-250	5000	107208	865 00
25000	500-650	12000	107209	875 00
30000	100-125	3200	107210	900 00
30000	200-250	6000	107211	910 00
30000	500-650	16000	107212	920 00

Three-Wire

100	220	20	196679	390 00
200	220	40	147233	400 00
400	220	80	147234	420 00
600	220	120	147235	430 00
800	220	160	147236	455 00
1000	220	200	147237	470 00
1500	220	320	147238	510 00
2000	220	400	147239	545 00
2500	220	500	147240	575 00

\*Where paper of capacity specified is not listed, use paper of .001 or 1000 times the numerical capacity, reading in megawatts or watts. Thus for 2.4 kilowatts use 2400 (watts) paper; for 16,000 kilowatts use 16 (megawatts) paper, etc.

†The control circuit is wound for the same voltage as the voltage circuit of the measuring element.

TYPE R RECORDING FREQUENCY METERS

The measuring element is always 110 volts (nominal). One Voltage transformer is required on

voltages above 110 volts. An external resistor is furnished for the voltage circuit.

Frequency Cycles	Control Circuit	Style No. Rear Connected	Style No. Front Connected	List Price
25	110-volts, d-c.....	374846	372629	\$275 00
25	110-volts, 25 Cycles.....	374847	372630	275 00
25	110-volts, 60 Cycles.....	374848	372631	275 00
25	250-volts, d-c.....	374849	372632	280 00
60	110-volts, d-c.....	374850	372633	275 00
60	110-volts, 25 Cycles.....	374851	372634	275 00
60	110-volts, 60 Cycles.....	374852	372635	275 00
60	250-volts, d-c.....	374853	372636	280 00

Order by Style Number

TYPE R SWITCHBOARD RECORDING INSTRUMENTS—Continued

TYPE R D-C. RECORDING AMMETERS

One 50 millivolt (see Type G Shunts) ammeter shunt is required, but is not included in style number and list price. Eight foot shunt leads are included; prices for extra lengths on request. Three-wire

meters are used on Edison three-wire system for recording the average of the currents in the outside wires. Two shunts are required for three-wire meters.

Kind of Meter	Control Circuit	Style No.	Style No.	List Price
		Rear Connected	Front Connected	
2-wire	110-volts. d-c.	372649	372637	\$235 00
2-wire	250-volts. d-c.	372650	372638	240 00
3-wire	110-volts. d-c.	372651	372639	235 00
3-wire	250-volts. d-c.	372652	372640	240 00
Speed Recorder*	110-volts. d-c.	372645	372641	245 00
Speed Recorder*	110-volts. 25 Cycles.	372646	372642	245 00
Speed Recorder*	110-volts. 60 Cycles.	372647	372643	245 00
Speed Recorder*	250-volts. d-c.	372648	372644	250 00

\*For use with magneto to record speeds by recording voltage developed by magneto.

GRAPHIC POWER FACTOR METERS

Two kinds of paper are listed for these instruments, one recording from 100 per cent to 60 per cent power factor, either lagging or leading; the other recording 100 per cent to 10 per cent lagging, and 100 per cent to 80 per cent leading. The instruments will be calibrated for use with either paper, as desired. An external resistor is furnished for the voltage circuit.

The styles listed below are front connected.

Single-Phase

The measuring element is always 5 amperes, 110 volts (nominal). One current transformer is required with each instrument having a capacity above 5 amperes and one voltage transformer on voltages above 110 volts.

Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price	Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price
	Volts	Current				Volts	Current		
25	110	d-c.	71664	\$270 00	60	110	d-c.	71667	\$270 00
25	220	d-c.	72321	275 00	60	220	d-c.	72324	275 00
25	550	d-c.	72322	280 00	60	550	d-c.	72325	280 00
25	110	A-C. 25 cycles	72323	270 00	60	110	A-C. 60 cycles	72326	285 00

Two-Phase

Two current transformers are required for all capacities and one voltage transformer for higher voltages than 110 volts.

Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price	Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price
	Volts	Current				Volts	Current		
25	110	d-c.	71665	\$270 00	60	110	d-c.	71668	\$270 00
25	220	d-c.	72327	275 00	60	220	d-c.	72330	275 00
25	550	d-c.	72328	280 00	60	550	d-c.	72331	280 00
25	110	A-C. 25 cycles	72329	270 00	60	110	A-C. 60 cycles	72332	285 00

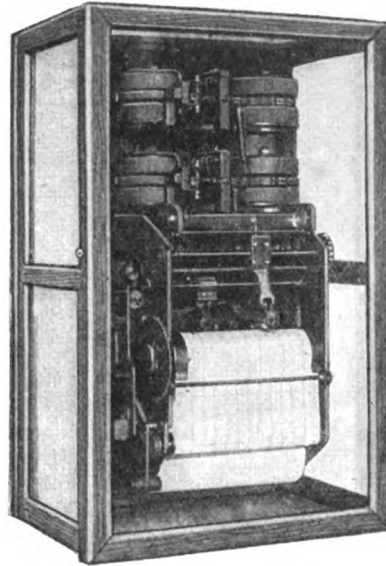
Three-Phase

Two current transformers required for all capacities and one voltage transformer for higher voltages than 100 volts.

Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price	Measuring Element Frequency, Cycles	CONTROL CIRCUIT		Style No.	List Price
	Volts	Current				Volts	Current		
25	110	d-c.	71666	\$270 00	60	110	d-c.	71669	\$270 00
25	220	d-c.	72333	275 00	60	220	d-c.	72336	275 00
25	550	d-c.	72334	280 00	60	550	d-c.	72337	280 00
25	110	A-C. 25 cycles	72335	270 00	60	110	A-C. 60 cycles	72338	285 00

Order by Style Number

## TYPE R DUPLEX RECORDING INSTRUMENTS FOR ALTERNATING-CURRENT CIRCUITS



TYPE R DUPLEX INSTRUMENT

**Applications**—The type R duplex recording instruments are used for metering two circuits so that both records are on one chart. It is possible to record on the same chart by this instrument the characteristics of two circuits for direct comparison, thus eliminating the troublesome comparison of two separate charts. In calculating kv-a, one element may be used for recording reactive kv-a while the other for recording kw. The two elements may be used to record voltage, frequency, and current values.

These instruments can be made for any two standard capacities as listed under type R switchboard recording instruments, also see the list of charts.

**Operation**—The type R duplex recording instruments operate on the same principles as the standard motor operated type R switchboard recording instruments. The characteristics with respect to operation and limit are the same as the switchboard recording.

**Construction**—The instrument is composed of two graphic recording mechanisms such as de-

scribed under type R switchboard recording instruments with the exception that only one clock, one paper drum, and one paper rolling mechanism is used. Each element is of the Kelvin balance type and is entirely independent of the other and may be constructed for various forms of instruments (frequency, voltmeter, ammeter and wattmeter) and controls a self-feeding pen.

**Case**—All duplex instruments are rear-connected with wooden frame, with wooden doors of the hinged type and with glass windows.

**Instructions for Ordering**—When ordering specify: the type of elements wanted, the ratio of current transformers of each current circuit, the ratio of voltage transformer of each voltage circuit, the voltage and the frequency of the control circuit, and the speed of paper desired (2, 4 or 8 inches per hour).

**Dimensions**—The overall measurements are 22 inches high,  $13\frac{7}{8}$  inches wide, and  $9\frac{1}{4}$  inches deep, not including the length of mounting bolts.

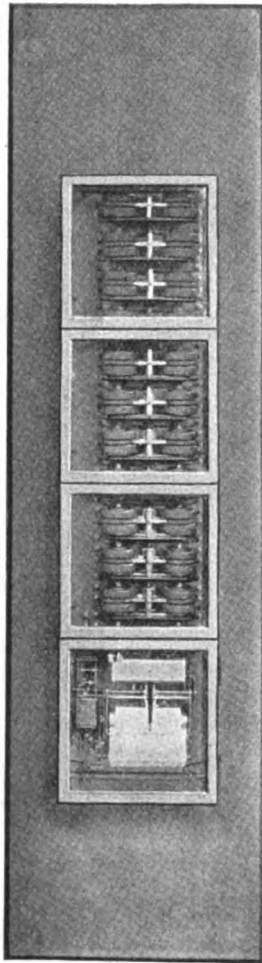
**Prices**—Prices will be quoted on request.

# TYPE R TOTALIZING RECORDING WATTMETER

## Application

Used for measuring the total power in a group of two to twelve independent circuits.

It is possible to record on this instrument the total power in several circuits not in synchronism



TYPE R TOTALIZING WATTMETER  
TWELVE-CIRCUIT

or of different characteristics, such as, frequency, transformer ratio, and voltage. With the single-circuit recording instruments this is impossible.\*

Number of Circuits	Approximate Dimensions of Panel Inches	Style No.	List Price
2	2x16x25	219302	\$750 00
3	2x16x25	219303	1000 00
4	2x16x32	219304	1250 00
5	2x16x32	219305	1500 00
6	2x16x36½	219306	1750 00
7	2x16x45	219307	2000 00
8	2x16x45	219308	2250 00
9	2x16x65	219309	2500 00
10	2x16x65	219310	2750 00
11	2x16x65	219311	3000 00
12	2x16x65	219312	3250 00

\*In case several feeders or other circuits operate always in synchronism and have equal transformer ratios, the usual single-circuit instrument can be made to record the total power by paralleling the secondaries of the current transformers, and using an instrument with a series coil of sufficient capacity.

These instruments can be made for any capacity and frequency and can be used with instrument transformers in service, even though of different ratios. However, an element designed to be operated with certain transformers cannot be used with transformers of other capacities. The calibration is not affected by change of frequency.

## Operation

The measuring elements are all mechanically connected to one set of contacts, so that it is the total pull of all the elements that closes and opens the contacts.

The control element is supplied for operation by either direct-current or by alternating-current, as ordered.

The standard instruments are provided with slate bases 16 inches wide and 2 inches thick. With additional panels above and below to match the height of the switchboard, this instrument can be assembled as a panel in a switchboard. In order that this instrument should be a self-contained removable unit, no other apparatus should be mounted on the meter base.

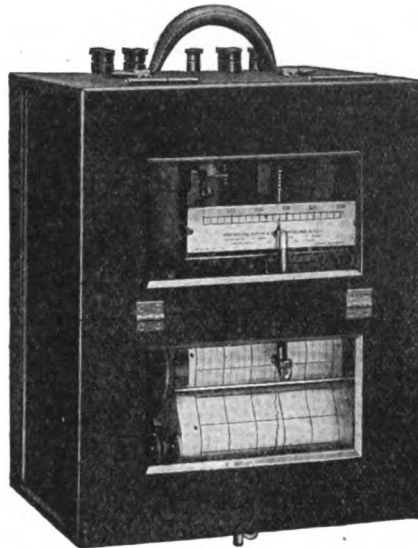
**Additional Circuits**—It is sometimes desirable to provide for future increase in the number of circuits. Extra elements cannot readily be added, without returning the entire instrument to the factory, but if the instrument is built with the total number of elements which eventually will be required, provision can be made for obtaining good records on the relatively small loads carried at first and later changing the connections so that the higher loads will be within the range of the scale. The possible ratio of maximum to minimum full-scale capacity depends upon the number of circuits and upon their relative capacities.

**Instructions for Ordering**—When ordering, order by style number and specify: ratio of current transformer of each circuit to be measured; ratio of voltage transformer of each circuit to be measured; frequency of control circuit; voltage of control circuit; size and drilling of panel, if special. Speed of paper (whether 2, 4 or 8 inches per hour). Any special features desired.

**Style number and list price** include totalizing recording wattmeter complete with the elements for the number of circuits described; such as special size base.



## TYPE R PORTABLE RECORDING INSTRUMENTS



TYPE R PORTABLE RECORDING WATTMETER  
THREE-PHASE A-C.

### Application

There are certain applications of portable recording instruments where records that are as accurate and reliable as those obtained on large switchboard graphic instruments are necessary. Among these applications are analysis of motor operation, typical consumption curves of large industrial consumers, and records showing power distribution. All of these require graphic records covering long periods of time, and records that are as accurate as is possible to obtain. The type R portable recording instruments being an adaptation of our switchboard type of instrument, fulfills all of these requirements. The difference between the two is that the switchboard element as a whole is mounted in a portable carrying case. An electric self-winding clock is used for speeds up to 24 inches per hour. A hand-wound clock can be supplied for speeds up to 4 inches per hour.

### A-C. Ammeters

These instruments have a nominal capacity of 5 amperes and may be used on any frequency or on a direct-current circuit not exceeding 5-amperes, but cannot be operated from a shunt for higher direct current ranges. For higher alternating-current

ranges, the instrument should be operated with current transformers. The 5-ampere full-scale calibration may be varied from 4 amperes to  $7\frac{1}{2}$  amperes if required to suit current transformer capacities.

Order should specify full scale rating desired according to the paper capacity selected, the speed of paper, and ratio of current transformer.

Capacity Amperes	Control Circuit Volts, D-C.	Style No.	List Price
5	25 and 60 cycles 110	289426	\$330 00

### A-C. and D-C. Voltmeters

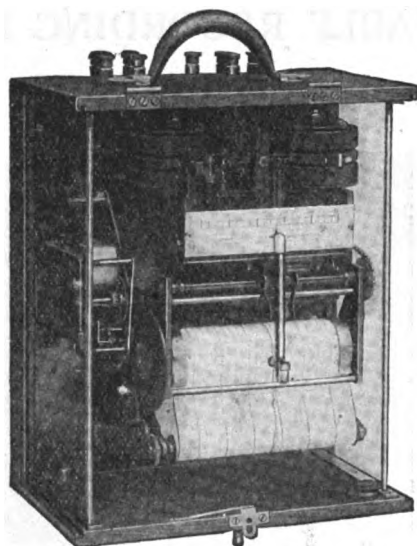
These instruments are correct at any frequency. For higher alternating-current voltages than those listed, the 90 to 140 volt range should be selected and operated from a voltage transformer.

Voltmeters may be calibrated with readings beginning from zero if desired, using any standard ammeter paper listed. This paper is marked "recording meter" and is suitable for use with volt meters as well as ammeters.

Order should specify full scale rating desired according to paper capacity, speed of paper, and ratio of voltage transformer.

*Order by Style Number*

## TYPE R PORTABLE RECORDING INSTRUMENTS—Continued



TYPE R PORTABLE RECORDING WATTMETER  
WITH COVER REMOVED

Capacity Volts	Control Circuit Volts D-C., 25 and 60 Cycles	Style No.	List Price
90-140	110	289428	\$330 00
180-280	110	289430	330 00
250-450	110	289432	330 00
360-560	110	289434	330 00
450-700	110	289436	330 00

### Single and Polyphase Wattmeters

The instruments listed below are polyphase wattmeters. For single-phase service the current binding posts are to be connected in series, and the voltage binding posts in parallel and the calibration made by the use of  $\frac{1}{2}$  as a multiplier. The instruments listed have a nominal capacity of 5 amperes and may be used on any frequency or on a direct-current circuit not exceeding 5 amperes, but cannot be operated from shunt for higher direct-current ranges. For higher alternating-current ranges current transformers should be used. The 5 ampere full scale rating may be varied from 4 amperes to  $7\frac{1}{2}$  amperes to suit current transformer and scale required. For single-phase, one current transformer is necessary. For 3-phase 3-wire or for 2-phase, two current transformers are required. For 3-phase 4-wire, or 3-phase 6-wire, three current transformers are required. For higher voltages than listed, the 110-volt instruments should be operated with voltage transformers, one being required for single-phase and two for polyphase.

Order should specify the full scale rating desired according to paper capacities selected, speed of the

paper, and the ratio of current and voltage transformer.

If control circuits of other capacity than listed are desired, communicate with nearest District Office.

Amps.	Volts	Control Circuit Volts, D-C., 25 and 60 Cycles	Style No.	List Price
5-10	110	110	289438	\$330 00
5-10	220	110	289440	330 00
5-10	550	110	289442	330 00

### Dimensions and Weights

The approximate dimensions are: over all width,  $13\frac{1}{4}$  inches, over all length,  $16\frac{1}{2}$  inches, over all depth,  $9\frac{1}{2}$  inches.

Net weight of one instrument is 35 pounds, shipping weight, 170 pounds.

Style number and list price include instrument with one roll of standard paper, two pens, one filler, one bottle of ink, one indicating dial and pointer, but without transformers.

Voltage transformers should have a secondary voltage of 100 volts at the nominal voltage of the circuit.

Current transformers should have a secondary current of 5 amperes at the maximum reading of the instrument.

For further information on instrument transformers, see pages on current and voltage transformers.

Order by Style Number

## PAPER FOR USE WITH TYPES M AND R RECORDING INSTRUMENTS

**Standard Paper**—Graphic instrument paper is supplied in rolls of 248 feet. A roll is sufficient for 62 days' record at the rate of 2 inches per hour, 31 days at 4 inches per hour, or 15½ days at 8 inches per hour. The prices of standard paper rolls are:

Quantity	List Price
In lots of 9 rolls or less, per roll.....	<b>\$4.00</b>
In lots of 10 to 99 rolls, per roll .....	<b>3.75</b>
In lots of 100 rolls or more, per roll.....	<b>3.00</b>

One roll of standard paper is supplied with each instrument without extra charge.

**"Blank"** paper has ruling same as other styles, the time and capacity numbers being omitted, permitting use of this paper for special purposes. The prices are the same as for standard paper.

**Special Paper**—All instrument paper is considered special which has markings different from those

listed. The "special" paper is intended to cover capacities not covered by "standard," but is not intended for obtaining special markings, numberings, and so forth, where the standard paper will answer equally well, nor will special colored ink markings or special length or quality of paper be furnished under terms listed for "special" paper.

Special paper rolls have the same length as standard rolls and will not be supplied in lots of less than 100 rolls. On orders for special paper we reserve the right in filling orders to deliver 2 rolls over or under quantity ordered according to run of press. Billing will be according to actual number of rolls delivered. Prices of special paper quoted on application.

**Style numbers** listed include one roll of standard paper, marked as indicated.

### Standard Paper for A-C. Ammeters—Type M and Solenoid-operated Type

Capacity Amp.	STYLE NO.			Capacity Amp.	STYLE NO.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour		2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
5	121128	121129	121130	500	59085	84727	84748
10	66298	84715	84736	600	66308	84728	84749
20	66299	84716	84737	800	65766	84729	84750
30	120456	120464	120472	1000	66309	84730	84751
32	66300	84717	84738	1200	66310	84731	84752
40	66301	84718	84739	1600	65769	84732	84753
50	120457	120465	120473	2000	66311	84733	84754
60	66302	84719	84740	2400	66312	84734	84755
80	65767	84720	84741	3000	120459	120467	120475
100	66303	84721	84742	3200	66313	84735	84756
120	66304	84722	84743	4000	120460	120468	120476
160	65768	84723	84744	5000	120461	120469	120477
200	66305	84724	84745	6000	120462	120470	120478
250	99839	99840	99841	8000	120463	120471	120479
300	120458	120466	120474				
320	66306	84725	84746	Blank	No Time Markings		
400	66307	84726	84747	Blank	20 divisions	84691	
				Blank	24 divisions	84692	
				Blank	32 divisions	84693	

### Standard Paper for A-C. Type R Ammeters

Capacity Amp.	STYLE NO.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
5	372669	372670	372671
10	372672	372673	372674
15	372675	372678	372677
25	372678	372679	372680
50	372681	372682	372683
70	372684	372685	372686
100	372687	372688	372689
150	372690	372691	372692
200	372693	372694	372695
300	372696	372697	372698
400	372699	372700	372701
500	372702	372703	372704
750	372705	372706	372707
1000	372708	372709	372710
1500	372711	372712	372713
2000	372714	372715	372716
2500	372717	372718	372719
3000	372720	372721	372722
4000	372723	372724	372725
Blank	50 divisions.....		372735
Blank	75 divisions.....		372736
Blank	40 divisions.....		372737

Order by Style Number

PAPER FOR USE WITH TYPES M AND R RECORDING INSTRUMENTS—Continued

Standard Voltmeter Paper—Alternating or Direct-Current

For use with Type M and Solenoid-operated Type

Capacity Volts	STYLE No.			Capacity, Volts	STYLE No.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour		2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
90-140	59084	84600	84603	360-560	99708	99709	99710
180-280	69902	84601	84604	450-700	69903	84602	84605
250-450	99712	99713	99714	Blank	50 divisions, no time marking.		

NOTE—Special paper can be furnished for reading the primary voltage directly when 90-140-volt instruments are used with transformers on high voltages. However, the use of above paper to indicate the secondary voltage is always recommended instead

Standard Voltmeter Paper—Type R Instruments

Capacity Volts	STYLE No.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
90-140	372653	372654	372655
180-280	372656	372657	372658
250-450	372660	372661	372662
360-560	372663	372664	372665
450-700	372666	372667	372668

Paper for A-C. and D-C. Wattmeters and D-C. Ammeters

For use with Type R, Type M or Solenoid-operated Meters

Capacity, Amp. or Kw.	STYLE No.			Capacity, Amp. or Kw.	STYLE No.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour		2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
10	66276	84636	84663	600	66290	84651	84678
16	66277	84637	84664	800	63718	84652	84679
20	66293	84638	84665	1000	66291	84653	84680
24	108058	108059	108060	1200	66292	84654	84681
30	120438	120444	120450	1500	120443	120449	120455
32	66278	84639	84666	1600	63720	84655	84682
40	66279	84640	84667	2000	59601	84656	84683
50	66280	84641	84668	2400	66319	84793	84811
60	66281	84642	84669	2500	120442	120448	120454
80	66282	84643	84670	3000	120440	120446	120452
100	66283	84644	84671	3200	63719	84657	84684
120	66284	84645	84672	4000	66294	84658	84685
160	66285	84646	84673	5000	66295	84659	84686
200	66286	84647	84674	6000	65763	84660	84697
240	108064	108065	108066	8000	91244	91245	91246
250	120441	115850	120453	10000	66042	84799	84817
300	120439	120445	120451	12000	59086	84661	84698
320	66287	84648	84675	Blank	84606	20 divisions, no time marking.	
400	66288	84649	84676	Blank	84607	24 divisions, no time marking.	
500	66289	84650	84677	Blank	84608	32 divisions, no time marking.	

Zero-Center Paper for A-C. and D-C. Wattmeters and D-C. Ammeters

Capacity, Amp. or Kw.	In. per Hour	Style No.	Capacity, Amp. or Kw.	In. per Hour	Style No.	Capacity, Amp. or Kw.	In. per Hour	Style No.	Capacity, Amp. or Kw.	In. per Hour	Style No.
4-0-12	2	209914	600-0-600	2	138186	1500-0-3000	2	238127	4000-0-4000	2	130623
10-0-40	2	241279	800-0-800	2	171188	1600-0-3200	8	120193	6000-0-6000	2	133629
50-0-200	2	139962	800-0-800	8	108207	2000-0-2000	2	140086	6000-0-12000	2	98801
120-0-120	4	201858	800-0-1600	4	126529	2000-0-2000	8	239295	6000-0-12000	4	108474
160-0-160	2	252687	1000-0-1000	2	209837	2000-0-6000	2	258885	5000-0-45000	4	242576
200-0-600	2	214975	1000-0-4000	2	231530	2000-0-6000	4	197027	8000-0-8000	2	132658
300-0-300	2	91331	1500-0-1500	2	224721	2000-0-12000	2	250122	10000-0-5000	2	136176
400-0-1600	4	173804	1500-0-1500	4	247375	2400-0-2400	2	98798	8000-0-8000	4	171187
500-0-500	2	153706	1500-0-1500	8	163134	3200-0-3200	2	104167	12000-0-12000	2	252592

NOTE—For higher capacities, use paper graduated in higher units; thus, for 50,000 kilowatts, use 50 megawatt paper. For low capacities, use paper listed and read in watts instead of kilowatts; thus, for 5 kilowatts, use, 5000 paper, etc.

Order by Style Number

PAPER FOR USE WITH TYPES M AND R RECORDING INSTRUMENTS—Continued

**Standard Frequency Meter Paper**

For use with type M and Solenoid-Operated Meters

Frequency Range Cycles	STYLE No.			Frequency Range Cycles	STYLE No.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour		2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
21-29	110354	110355	110356	42-58	120480	120481	120482
26-34	114840	114841	114842	52-68	110357	110358	110359
32-48	119655	119656	119657	Blank	No Time Marking 110360		

**Standard Frequency Meter Paper—Type R Instruments**

Frequency	STYLE No.		
	2 Inches per Hour	4 Inches per Hour	8 Inches per Hour
25	372726	372727	372728
60	372729	372730	372731
Blank	No Time Marking 372734		

**Standard Power Factor Meter Paper**

Power Factor Range Per Cent	Style No.	Feed Rate Inches per Hour	Power Factor Range Per Cent	Style No.	Feed Rate Inches per Hour
60-100-60	84687	1	10-100-80	119157	2
60-100-60	84688	2	10-100-80	119158	4
60-100-60	84689	4	10-100-80	119159	8
60-100-60	84690	8	10-100-80	119160	Blank
60-100-60		Blank	.....	.....	.....

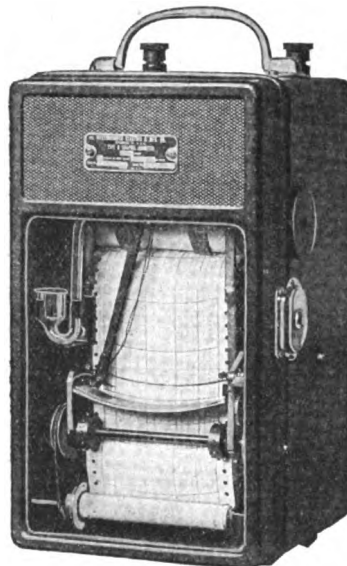
**SPARE PARTS**

Style No.	Description	List Price
122429	Capillary reservoir pen.....	\$2 50
122430	Holder for above pen.....	25
72449	Rubber pen filler.....	50
108067	Green ink in concentrated form, to be added to one quart of distilled water. Postage prepaid....	25
329157	Red Ink in concentrated form, to be added to one quart of distilled water. Postage prepaid.....	25
321366	Blue Print Red Ink in concentrated form, to be added to one quart of distilled water. Postage prepaid	25
247072	One quart of red ink ready for use.....	1 00
219079	Pen cleaning wires.....	\$0 05 doz. net

Clock and clock parts for speeds of 1, 2, 4, 8 or 24 inches per hour direct-current or alternating-current control can be supplied. When requesting quotations, state the present speed and control circuit and new speeds or new control circuit desired, also style number of instrument with which they are to be used.

*Order by Style Number*

## TYPE U RECORDING AMMETERS AND VOLTMETERS SWITCHBOARD AND PORTABLE



TYPE U RECORDING AMMETER

### Application

Intended for purposes where recording instruments that are easily operated, light in weight, comparatively low in price, and reasonably accurate, are required. Type U instruments permit central stations to secure at a reasonable cost, records, which would otherwise not be taken on account of the expense.

**Arc Light Circuits**—A graphic chart showing the actual time the arc lamps are in operation each night and the actual current supplied to the lamps will settle any disputes with municipal authorities.

**Service Voltage**—An instrument on the service end of each feeder provides a record of actual conditions. The type U voltmeter is light, easily set up, and transferred from one feeder to another, thus furnishing a number of records at minimum expense.

**Customers' Load Curves**—A type U recording ammeter is the simplest means for obtaining the load curve of a prospect's or customer's plant, from which maximum demand, load factor, and diversity factor can be quickly approximated. A type U three-wire ammeter is particularly useful for this purpose on three-wire loads.

**Station Curves**—Mounted on the station or substation switchboard, type U instruments will give records of the variation in current and voltage.

**Settling Disputes**—During recent years graphic instruments have come into extensive use in settling disputes with customers. The records often disclose the use of power at unexpected hours. The type U instrument, because it can be installed easily and quickly is particularly adapted for such service.

**Other Uses**—There are innumerable uses for a graphic instrument of this character. Locating leaks and theft of current, determining most economical hours for operating generators of various sizes, checking up the distribution of load between units, and many other uses will suggest themselves to every central station man.

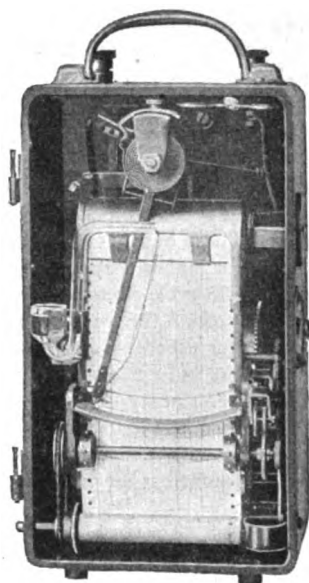
### Operation

The instrument consists of a solenoid and core acting on an arm that carries the recording pen, and a continuous strip of paper moved uniformly by a clock mechanism. To overcome the slight friction of the pen on the paper, the solenoid is made powerful in its action. Its action is controlled by a heavy spring, which minimizes inaccuracies due to slight errors in leveling. The energy consumed by the voltmeter, including its external resistor, is 25 watts. The energy consumed by the ammeter is 7 watts, thus adapting it for use with ordinary current transformer for currents higher than the current rating of the instrument.

**Accuracy**—It should be noted that the purpose of the records divides the accuracy requirements of graphic instruments naturally into two classes. For some applications, accuracy is the prime requisite, and extreme accuracy can be maintained only by a rather expensive instrument. There are many purposes, however, where simplicity of parts and ease of manipulation, such as in type U instruments, are more important than extreme accuracy and instruments designed on this basis result in considerably lower cost.

**Adjustments**—Simple spring adjustment is provided to set the zero on the ammeters. On the volt-

## TYPE U RECORDING AMMETERS AND VOLTMETERS—Continued



TYPE U AMMETER—WITH COVER REMOVED



HIGH-VOLTAGE TYPE U AMMETER

meters, which are made with suppressed zero, this adjustment varies the readings above the middle of the scale. For the lower half of the scale an additional adjustment is provided in the form of a counterweight, pivoted on a separate shaft, which is picked up by the main movement and serves to keep the scale more nearly uniform at the lower end.

### Construction

**Dashpot**—A dashpot damps the action of the instrument on fluctuating current or voltage. On circuits not subject to excessive fluctuations the oil can be left out of the dashpot.

**Case**—The instrument is contained in a metal case having a glass window for observing the movement of the pen. The standard instrument is adapted for either switchboard mounting or portable use. The hinged handle makes it convenient to carry the instrument about and the lug can be used for hanging the instrument on a wall for temporary testing or while being stored in the instrument room.

The lug and handle are detachable and are removed when the instrument is mounted on a switchboard. Three mounting studs are supplied and the base has the necessary drilling and tapping for these studs.

The pen is of the V-point type familiar to operators of graphic recorders.

A glass ink reservoir, which holds a supply of ink sufficient for three weeks or more of ordinary use, feeds the ink into the pen as used.

The ink is furnished in liquid form, specially prepared for use with the pen and paper supplied. A small clip inside the instrument case serves to

hold the ink phial, Style No. 174005, so that the ink is always on hand when wanted.

The record paper is furnished in 16-foot rolls, ruled for a speed of one inch per hour; and the 32-foot rolls, for a speed of two inches per hour. A roll is sufficient for 8 days' record. The time markings are half inch apart and the capacity markings agree with the calibration of the instrument used. The paper is  $3\frac{1}{4}$  inches wide, scale  $2\frac{1}{2}$  inches.

The paper driving mechanism is a pair of sprockets driven through gearing by a standard eight-day clock mechanism. The clock is of key-wound type with balance wheel escapement. Under normal conditions winding once a week is sufficient, but winding twice a week is recommended to insure against stoppage. The standard rate of drive is one inch per hour, but instruments for two inches per hour can be supplied on order at the standard price. A two-inch-per-hour mechanism is also listed for changing instruments already in use.

### Standard Type U Recording Instruments

The instruments are insulated for a maximum of 750 volts.

**Voltmeters** have suppressed-zero scales to obtain large divisions in the part of the scale used. An external resistor is furnished with each.

**Ammeters** are made up to and including 80 amperes. Direct-current ammeters for higher currents cannot be furnished, but alternating-currents of any magnitude can be measured by means of the 5-ampere ammeter with a current transformer.

**High-voltage Ammeter**—The specially-insulated ammeter is for connection in arc circuits or other

**TYPE U RECORDING AMMETERS AND VOLTMETERS—Continued**

high-voltage lines. The case is made of hardwood material instead of metal. The cover can be locked to prevent unauthorized persons from opening it. As long as the cover remains closed this ammeter may safely be handled while connected to a circuit operating at any voltage up to 7000 volts. Interior metal parts have standard 600-volt insulation between them and the coil, and should not be handled while the instrument is connected to a high-voltage circuit. There will generally be opportunities to wind the clock and to attend to the pen and chart while the circuit is not alive.

**Three-wire ammeters** record the total current in both outside wires of a three-wire system. They are useful in obtaining a record of the total load on a three-wire installation, but are recommended for use on direct-current circuits only. For three-wire alternating-current circuits the 5-ampere two-wire instrument with a three-wire current transformer is preferable. (For three-wire current transformers see pages on "Current Transformers.")

**Instruments with Zero Center**—As type U instruments are not polarized, it is impossible to furnish them with zero center.

**Portable Testing Outfit**—This outfit consists of a

portable split-type current transformer, Style No. 117508 (see page on portable instrument transformers), and a 5-ampere type U recording ammeter, Style No. 205889, and provides a convenient means of measuring currents up to 250 amperes in an overhead line, without opening the circuit.

The transformer connections can be made for obtaining full-scale reading on either 125 or 250 amperes primary. These outfits can be calibrated for use on 40 cycles or higher frequencies, but are not recommended for 25-cycle circuits. The instrument is calibrated for use with the transformer, and a correction curve is furnished. No curve is furnished with an instrument to be used with transformer in customer's possession unless the transformer is returned to the factory for the test. By the use of this curve an accuracy within five per cent can be obtained, this being sufficient for giving a good idea of load conditions.

**Overall Dimensions  
Inches**

Width.....	5½
Height.....	9¾
Depth.....	5¾

**PRICES**

Style number and list price include instrument complete with five rolls of paper and a two-ounce bottle of ink. The standard instrument is equipped with a one-inch-per-hour paper-driving mechanism. For the two-inches-per-hour mechanism order "Sim-

ilar to Style No....., except with two-inches-per-hour paper-driving mechanism." Style number and list price on uncalibrated instruments include calibration of instrument as ordered. Specify frequency and scale marking when ordering.

**Type U Recording Voltmeters**

UNCALIBRATED*		CALIBRATED ON DIRECT-CURRENT		CALIBRATED ON 60-CYCLE ALTERNATING-CURRENT		List Price
Nominal Volts	Style No.	Scale	Style No.	Scale	Style No.	
110	173204	90-130	190383	90-130	190379	\$ 85 00
		120-180	304799	120-180	304800	90 00
220	173205	180-260	190384	180-260	190380	90 00
		240-360	304801	240-360	304802	95 00
440	173208	360-520	198721	360-520	198723	95 00
550	179555	450-650	198722	450-650	198724	100 00
110 } 220 }	199098†	{ 90-130 } { 180-260 }	199098†	{ 90-130 } { 180-260 }	199097†	95 00

**Type U Recording Ammeters**

UNCALIBRATED*		CALIBRATED ON DIRECT-CURRENT		CALIBRATED ON 60-CYCLE ALTERNATING-CURRENT		List Price
Capacity, Amperes	Style No.	Scale	Style No.	Scale	Style No.	
<b>Two-Wire</b>						
5	205889†	0-5	190385	0-5	190381	\$95 00
5	173207	{ 0-10 } { 0-15 } { 0-20 }	190386 304803 198718	0-10 0-15 0-20	190382 304804 198715	90 00 90 00 95 00
20	179557	0-25	304805	0-25	304806	95 00
40	179558	0-40	198719	0-40	198716	95 00
80	179559	0-80	198720	0-80	198717	100 00
<b>Three-Wire</b>						
..	.....	0-5	179560	.....	.....	110 00
..	.....	0-10	179561	.....	.....	110 00

\*Uncalibrated instruments will be calibrated as desired, for the ranges listed on each, for use on 25-cycle and odd-frequency alternating-current circuits.

†These are combination instruments, having two voltage ranges. The two ranges are obtained by taking out an extra tap on the series resistor. Paper should be used of a voltage range to correspond to the connection used. Unless otherwise ordered three rolls of 90-130-volt range and three of 180-260-volt range paper will be supplied with each instrument.

‡Specially wound for use with split-type Testing Transformer. Price includes instrument with necessary calibration curve, but does not include the transformer.

Order by Style Number



TYPE U RECORDING AMMETERS AND VOLTMETERS—Continued

High-Voltage Ammeters

Capacity, Amperes	Maximum Volts	Style No.	List Price
10	7000	241314	\$110 00

Portable Testing Set

Scale, Amperes	Description	Style No.	List Price
125 or 250	Consists of Ammeter, Style No. 205889, and Transformer Style No. 117508	199363	\$160 00

Type U Recording Instrument Paper

Scale	VOLTMETER		Scale	AMMETER	
	1-inch per Hour	2-inches per Hour		1-inch per Hour	2-inches per Hour
0-150*	247562	247563	0-5	167817	192927
90-130	157916	188706	5.4-7.8*	269643	.....
100-160*	227156	289486	0-10	174415	199102
120-180	247566	247567	0-15	247570	247571
180-260	173209	199099	0-20	174416	199103
0-300*	247564	247565	0-25	247572	247573
240-360	247568	247569	0-30*	247574	247575
360-520	173210	199100	0-40	174417	199104
450-650	173211	199101	0-60*	247576	247577
.....	.....	.....	0-80	174418	199105

LIST PRICE PER ROLL	1-inch per Hour		2-inches per Hour	
	Quantity	Shipments	Rolls	Additional Discounts.
Lots of less than 50.....			\$0 20	\$0 40
	50-99			5%
	100-499			10%
	500-999			20%
	1000 or more			30%

\*For use in specially calibrated instruments not listed in this catalogue.

Accessories for Type U Recording Meter

Description	Style No.	List Price
¼-Ounce Phial of Red Ink	174005	\$0 30
2-Ounce Bottle of Red Ink	256332	0 50
8-Ounce Bottle of Red Ink	180201	2 00
1-Pint Bottle of Red Ink	180202	4 00
2-Ounce Blue Print Red Ink	321361	0 75
Ink Reservoir	183081	0 50
Pen Complete with Pen Arm	239347	2 00
Extra Clocks	136905	22 00

2-Inches-Per-Hour Paper-Driving Mechanism

For Changing Drive on Type U Recording Instruments Already in Use

Style number and list price include mechanism complete ready to install in instrument.

Description	Style No.	List Price
Gear Train	199210	\$2 00
Pinion	199211	30

Wick yarn for pen feed \$0.01 net per foot.

Approximate Weights—Voltmeter, including resistor, 10½ pounds net, 13½ pounds boxed; ammeter 9¼ pounds net, 12¼ pounds boxed.

Order by Style Number

## TYPE PI PORTABLE INSTRUMENTS

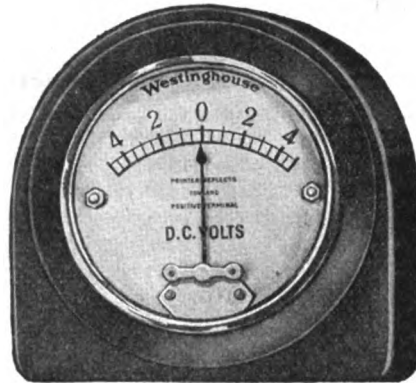
### DIRECT-CURRENT MINIATURE AMMETERS AND VOLTMETERS

2-Inch Dials

1½-Inch Scales



AMMETER



VOLTMETER

#### Application

The type PI portable instruments find a wide application where high accuracy is not required. They are handy and serviceable for tests on batteries, automobile or farm-lighting equipment, automobile ammeters, electrical toys, radio battery apparatus, trade or high school equipment, advertising samples, and for amateur experimenting.

#### Principle of Operation

No springs or moving coil are used in these instruments, so that great simplicity and ruggedness are obtained. Deadbeat indications are assured because of an efficient damper.

The type PI instrument utilizes the polarized vane construction, comprising a moving soft iron vane polarized by stationary permanent magnet and deflects the pointer over the scale by the action of the stationary current or voltage coil.

#### Distinctive Features

- Assembled in a moulded composition case.
- Handy size; fits the hand, weighs 6 oz.
- Clear and legible dial.
- Compactness and simplicity.

Polarity is indicated by deflection to the right or left of zero.

#### Construction

**Capacities**—Instruments are self-contained in the capacities listed, and no external shunts or resistors are required, except for the 50 volt and 130 volt voltmeters. The ammeters are not damaged by momentary short circuits up to 500 amperes.

**Dimensions**—The composition block is 2¼ inches overall and 1⅛ inch thick.

**Terminals**—Terminal studs extending from the back of instrument are provided with insulated knurled thumb nuts.

#### Ammeters

Amperes	Style No.	List Price
5-0-5	300759	\$4 00
10-0-10	300760	4 00
20-0-20	300761	4 00
30-0-30	300762	4 00

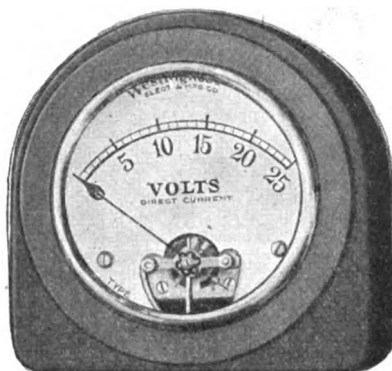
#### Voltmeters

Volts	Style No.	List Price
3-0-3	300763	\$7 00
5-0-5	300764	7 00
10-0-10	300765	7 00
15-0-15	300766	7 00
30-0-30	300767	7 00
50-0-50	300768	7 00
130-0-130	300769	9 00

Order by Style Number

## TYPE PX-2 MINIATURE PORTABLE INSTRUMENTS

### DIRECT-CURRENT AND RADIO-FREQUENCY ALTERNATING-CURRENT



#### Application

The type PX-2 portable instruments serve for automobile, battery and miscellaneous testing, and are particularly useful to amateurs and every one engaged in radio experimenting. They are of miniature size and are strictly high grade, accurate instruments. They should be used in a vertical position on a bench or table, for the greatest accuracy. For work of less precision, see type PI instruments.

#### Construction

**Capacity**—These instruments are self-contained for all capacities listed.

**Dimensions**—The composition block is  $2\frac{3}{4}$  inches by  $2\frac{3}{4}$  inches by  $1\frac{1}{8}$  inches thick.

**Terminals**—Terminal studs, extending from the back of instruments, are provided with knurled thumb nuts.

**Durability**—The instrument is so rugged that it will withstand such shocks as are inherent to ordinary service without injury. Because of the extremely light weight of the movement combined with the rugged case, maximum durability is obtained.

#### Ammeters

Style No.	Capacity Amperes d-c.	List Price
311740	1	\$11 00
311741	2	11 00
311742	3	11 00
311743	5	11 00
311744	10	11 00
311745	15	11 00
311746	25	11 00
311747	20-0-20	11 00
311748	30-0-30	11 00

#### Milliammeters

Style No.	Capacity Milliamperes d-c.	List Price
311758	100	\$11 00
311759	150	11 00
311760	250	11 00

#### Voltmeters

Style No.	Capacity Volts d-c.	List Price
311749	3	\$11 00
311750	8	11 00
311751	10	11 00
311752	16	11 00
311753	25	11 00
323702	30	11 00
323703	40	12 00
311754	50	12 00

#### \*Millivoltmeters

Style No.	Capacity Millivolts d-c.	List Price
*311771	50	\$11 00
*311772	100	11 00

\*These millivoltmeters are for use with separate ammeter shunts to give higher capacity readings. For the above millivoltmeters use shunts listed on pages 513 and 551.

TYPE PX-2 MINIATURE PORTABLE INSTRUMENTS—Continued



**Radio-Frequency Ammeters**

Style No.	Capacity Ampere	25 to 3,000,000 Cycles	List Price
311781	0.6		\$21 00
311782	0.8		21 00
311783	1.0		18 00
311784	1.5		18 00
311785	2.0		18 00
311786	3.0		18 00
311787	4.0		18 00

**Direct-Current Galvanometer**

Style No.	Description	List Price
311818	Zero Center, sensitiveness of 0.0001 amperes per division. Resistance 19.0 ohms	\$13 00

This galvanometer will find ready application for many purposes in electrical testing where a highly sensitive galvanometer is unnecessary.

**Large Portable Case**

This case can be used for any combination of six standard listed instruments required for any particular application.

Style number and list price include carrying case only.

Style No.	Description	List Price
312525	Portable Carrying Case	\$6 00

**Combination Garage Set**

This set of instruments is for garage use and the Westinghouse Electric & Manufacturing Company's set includes those which are most necessary to meet the needs of the average garage. The set, Style No. 312524 consists of the following:

	Style No.	List Price Complete
1	Portable Carrying Case	312525
1	PX-2 Ammeter 30-0-30 Amperes	311748
1	PX-2 Voltmeter 0-3 Volts	311749
1	PX-2 Voltmeter 0-16 Volts	311752
1	PX-2 Millivoltmeter 0-100 M. V. *	311772
1	400-Ampere Intermittent-use Shunt (To be used with above M. V. meter)	227582
		\$60 00

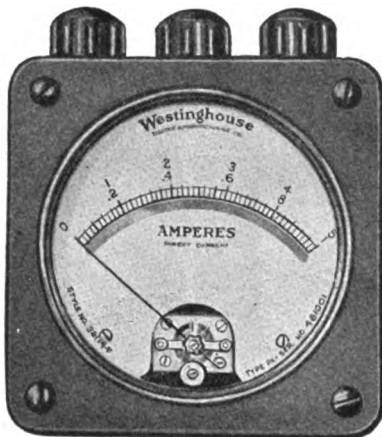
Cases containing any combination of instruments can be furnished upon request.

\*Includes one pair of shunt leads.

Order by Style Number

## TYPE PX-3 PORTABLE INSTRUMENTS

### DIRECT-CURRENT AND RADIO-FREQUENCY ALTERNATING-CURRENT



#### Application

The type PX-3 portable instruments are direct reading instruments for general testing purposes. They are very handy and serviceable and should have a wide application for central station analysis tests; for trade school, high school, and college-equipment work, for radio, and for battery apparatus measurements. The type PX-3 portable instruments are particularly adaptable for automobile and battery testing. A set of six different instruments will not be as bulky to carry as the ordinary large portable instrument and will serve the more complex tests with ease and convenience.

The general description under direct-current switchboard instruments applies to these instruments.

#### Construction

The complete movement is mounted on a micarta sub-base which can be removed as a unit. This allows the movement to be completely adjusted outside the case where all parts are accessible.

The cases are made of moulded composition. This material is not only strong but is acid-resisting which makes the instrument particularly useful for battery testing. These cases have, and will maintain, a very pleasing appearance, and they possess many advantages over wooden ones.

#### Ammeters\*

Style No.	Capacity Amperes d-c.	List Price
321144	0-1, 0-5	\$17 00
321145	0-2, 0-10	17 00
321146	0-4, 0-20	17 00
321142†	5-20-200	38 00
321143†	3-30-300	38 00

#### Milliammeters

Style No.	Capacity Milliampers d-c.	List Price
372254	0-10	\$17 00
372255	0-50	17 00
333602	0-100	17 00
333603	0-150	17 00
333604	0-250	17 00

#### Millivoltmeters

Style No.	Capacity Millivolts d-c.	List Price
372251	0-50	\$17 00
321147‡	0-100	17 00
372252	0-200	17 00

#### Radio Ammeters

Style No.	Capacity Amperes	List Price
333806	0-1	\$22 00
333806	0-2	22 00
333807	0-3	22 00
333808	0-4	22 00
333809	0-6	22 00
333810	0-8	22 00
333811	0-10	22 00

**Capacity**—The ammeters are self-contained for capacities up to and including 20 amperes. For higher values of current, external shunts are used with a millivoltmeter.

The voltmeters are limited to 150 volts self-contained. For voltage ranges above 150 and up to 300 volts, a small external resistor can be supplied at extra charge.

**Dimensions**—The case is 3½ inches by 3½ inches by 1½ inches thick.

**Terminals**—Terminal studs extending from the top of the case are provided with knurled, moulded insulated thumb nuts.

**Finish**—Standard finish is dull black marine.

**Weight**—The instrument weighs 13 ounces net and 1½ pounds boxed.

#### Voltmeters

Style No.	Capacity Volts d-c.	List Price
321148† (single scale)	.3-0-2.8	\$17 00
321149	0-2.5, 0-10	17 00
333601**	0-8, 0-40	18 00
321150	0-10, 0-100	20 00
321151	0-15, 0-150	20 00

#### Cadmium Electrode

Style No.	Description	List Price
356333	For use with Voltmeter Style No. 321148	\$3 25

\*Sensitive galvanometers can be made in this type of instrument. Prices on request.

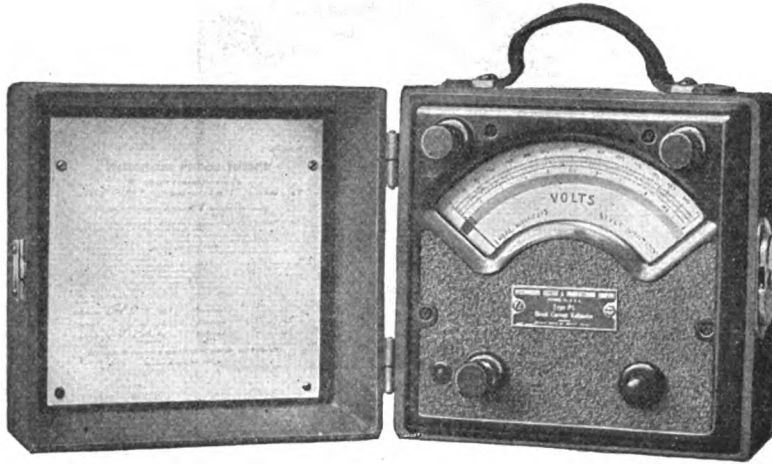
†With external shunt.

‡Specially for cadmium test on storage batteries.

§For use with external shunt if desired. Shunts are listed under this subject in Section 3-B.

\*\*Combination for testing both A and B batteries used in radio.

## TYPE PL PORTABLE INSTRUMENTS FOR DIRECT-CURRENT CIRCUITS



TYPE PL PORTABLE VOLTMETER

### Application

These are direct-reading portable instruments that meet the demand for high-grade, compact, and easily readable instruments for general testing work. They operate on the D'Arsonval principle, including a moving coil and permanent magnets. They differ, however, from other instruments using this principle, in having a single air-gap through which the moving coil, pivoted at one edge, swings.

### Construction

The complete movement is attached to a mounting plate of bakelized micarta and is easily removed for repairs. The removable insulating face-plate protects the pointer and scale and makes a dust-proof joint with the case. Single air-gap construction makes it possible to remove the moving coil without removing the pole pieces and thus without disturbing in any way the magnetic circuit, so that the strength of the magnetic field is not changed. The weight of the moving element is low because the eccentrically pivoted coil tends to counter-balance the pointer so that the counter-weight required is small, and the pivot jewels are therefore preserved from wear. The movement and pole

pieces are completely surrounded by the permanent magnets; thus greatly reducing the effect of external fields.

**Cases**—Instruments are mounted in polished wood carrying cases. They have hinged covers that are easily removable and flexible sole-leather handles.

**Damping**—The light metal frame on which the moving coil is wound moves through the air-gap of the magnets and makes the reading inherently deadbeat. This very important feature enables readings to be taken quickly, and prevents violent fluctuations from injuring the pointer or the moving element.

**Scale**—Scale subtends an arc of 100 degrees, and is  $6\frac{1}{2}$  inches long, giving large, open divisions which are of uniform length throughout. A mirror extending the entire length of the scale prevents parallax in reading.

**Finish**—All visible metal parts are finished in bright nickel, mounted on a polished black face-plate.

**Size**—Cases for the type PL portable instruments are  $6\frac{1}{4}$  inches by  $6\frac{1}{4}$  inches, 4 inches high, which is exceptionally small considering the length of scale.

## TYPE PL D-C. PORTABLE INSTRUMENTS—Continued

## TYPE PL AMMETERS

Type PL ammeters have the shunts contained in the case. For higher capacities than those for which the ammeters are listed, self contained instruments are not recommended because of possible temperature errors. This applies to all ammeters of this class. For such service, a millivoltmeter should be used, with separate shunt of the proper capacity.

The self-contained ammeters are marked with one scale divided so that even readings are obtained for both capacities. Two sets of figures are used, one for each capacity.

Style number and list price include self-contained ammeter as described.

Current Ranges, Amperes	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
0-0.5 and 0-2.5	5	12	165402	\$70 00
0-1 and 0-5	5	12	165403	70 00
0-2 and 0-10	5	12	165404	70 00
0-4 and 0-20	5	12	165405	70 00
0-6 and 0-30	5	12	165406	70 00

## Milliammeters

Current Ranges, Amperes	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
0-0.02	4	10	168170	70 00
0-0.05	4	10	168171	70 00
0-0.10	4	10	168172	70 00

## TYPE PL VOLTMETERS

Style number and list price include voltmeter complete as described.

Voltage Ranges	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
0-3 and 0-150	5	12	165407	\$75 00
0-15 and 0-150	5	12	165408	75 00
0-150 and 0-300	5	12	165409	75 00
0-150 and 0-750	5	12	165410	80 00
0-300 and 0-750	5	12	219355	80 00
0-15, 0-150 and 0-750	5	12	214480	85 00

Two-range voltmeters listed above can be sup-

plied with three ranges at an addition to the list price of \$10.00, the push button being omitted.

Resistors can be supplied for voltages higher than those listed.

All the voltmeters listed have a uniform resistance of approximately 100 ohms per volt capacity. Special voltmeters of higher sensitiveness can be furnished at extra cost. Each voltmeter has a push-button switch for making and breaking the circuit.

## TYPE PL MILLIVOLTMETERS

These instruments are for use with portable shunts in making current measurements. Instruments and shunts of 100 millivolts drop make possible more accurate measurements than the 50-millivolt combinations.

The scales of millivoltmeters are marked in millivolts unless otherwise specified and ampere readings are obtained by multiplying the reading in millivolts by the amperes-per-millivolt of the shunt.

Style number and list price include millivoltmeter complete without shunts. Style Nos. 165411 and 165412 can be marked in amperes instead of millivolts if desired, to suit any of the shunts of corresponding drop.

Scale, Millivolts	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
50	4	10	165411	\$70 00
100	4	10	165412	70 00
20 and 100	4	10	165413	70 00
50 and 250	4	10	165414	70 00
50 and 500	4	10	165415	70 00

## TYPE PL VOLT-AMMETER

The type PL volt-ammeter is a combined voltmeter and millivoltmeter for current measurements. It has three binding posts. The measuring element is connected directly between two binding posts and through a suitable resistor to the third post for voltage measurements. As a millivoltmeter it is for use with a 100-millivolt shunt.

Volt-ammeters have two scales, one reading volts and divided into 150 divisions as in the voltmeter, and the other divided into 100 divisions to read

millivolts. The second scale can be made to read directly in amperes if desired.

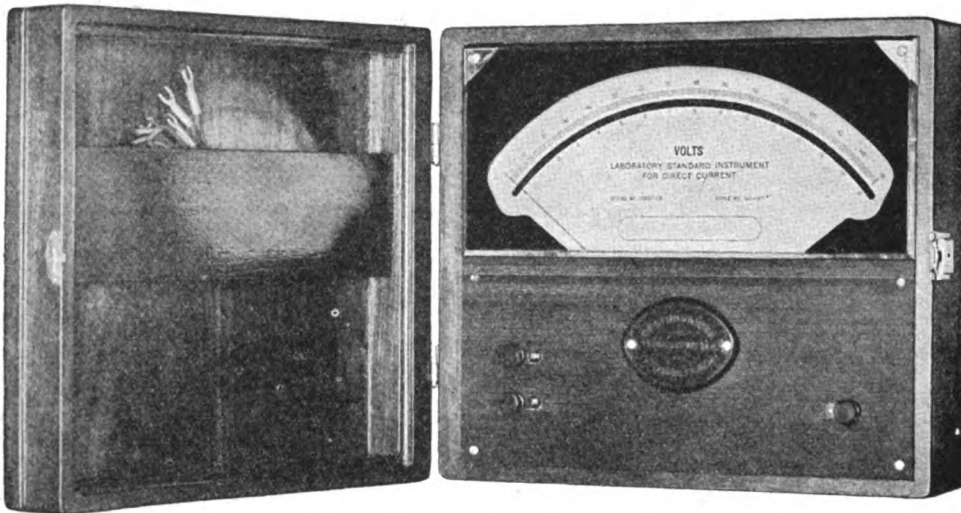
Style number and list price include instrument complete as described, without shunts. The volt scale will be calibrated for any voltage from 3 to 300 volts, but not higher. The ampere scale will be marked for 100 millivolts unless otherwise ordered, and can be used with any capacity of shunt of the proper drop.

APPROX. WT., LBS.	Style No.	List Price
Net	Boxed	
5	12	165416
		\$80 00

Order by Style Number

## TYPE PL PORTABLE LABORATORY INSTRUMENTS

### FOR DIRECT-CURRENT CIRCUITS



TYPE PL LABORATORY VOLTMETER

Type PL laboratory large-size instruments are particularly valuable where a long-scale semi-portable instrument is required. Like the regular size type PL instruments, they operate on the D'Arsonval principle, which renders them free from residual error.

#### Construction

The type PL laboratory instruments have the same general construction as the regular size type PL instruments.

**Damping**—The light metal frame on which the moving coil is wound moves through the air-gap of the magnets and makes the reading inherently deadbeat. This very important feature enables readings to be taken quickly, and prevents violent fluctuations from injuring the pointer or the moving element.

**Scale**—Scale subtends an arc of 100 degrees and is  $11\frac{1}{2}$  inches long, giving large, open divisions, which are of uniform length throughout. A mirror extending the entire length of the scale prevents parallax in reading.

**Finish**—All visible metal parts are finished in bright nickel, mounted on a polished black faceplate. Case is polished wood.

**Size**—Cases of the type PL portable laboratory

instruments are 12 inches by  $13\frac{3}{4}$  inches,  $4\frac{5}{8}$  inches high.

#### Scale Marking

**Voltmeters**—The type PL laboratory voltmeters are calibrated as ordered, for any capacity of from 3 to 750 volts. Resistors can be supplied for voltages higher than those listed. All the voltmeters have a uniform resistance of approximately 100 ohms per volt capacity. Special voltmeters of higher sensitiveness can be furnished at extra cost. Each voltmeter has a push-button switch for making and breaking the circuit.

**Millivoltmeters**—These instruments are for use with portable shunts in making current measurements. Instruments and shunts of 100 millivolts drop make possible more accurate measurements than the 50-millivolt combinations.

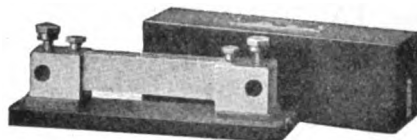
**Style number and list price** include instruments calibrated as ordered. The voltmeter will be calibrated as specified in the order for any capacity from 3 to 750 volts, and the millivoltmeter for any capacity from 25 to 500 millivolts.

Instrument	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
Voltmeter	8	18	165487	\$159 00
Millivoltmeter	7	17	165488	159 00

Order by Style Number



## TYPE PL PORTABLE SHUNTS



TYPE PL PORTABLE SHUNT

The type PL portable shunts are for use with type PL and type PX millivoltmeters and voltmeters. They are made of manganin, a material with minimum temperature coefficient and thermo-electro motive force. The resistance of each is accurately adjusted and, as the shunts have the same full-load drop, they are interchangeable—the terminals are generously proportioned. Unless otherwise stated each shunt is mounted in a portable box. The voltage drop in the shunts at full load is 100 millivolts, insuring high accuracy in readings.

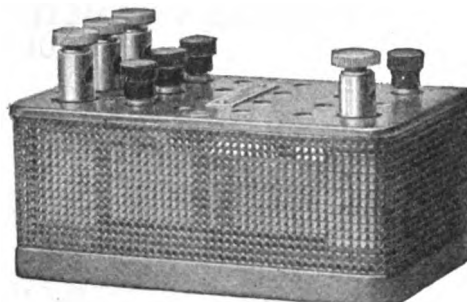
**Combination Laboratory Shunts**—Combination shunts including three shunts mounted in a single box with suitable terminals are listed for laboratory or semi-portable use. Combinations of any three shunts in capacities up to 200 amperes each can be furnished.

**Switchboard type G 50-millivolt shunts** listed on another page can also be used with millivoltmeters having 50-millivolt range.

### Type PL Portable Shunts 100 Millivolts

Style number and list price for shunts of capacities up to 1000 amperes include 100-millivolt shunt complete in polished wood case. Shunts of capacities above 1000 amperes are finished in line with switchboard-shunt practice and do not have carrying cases.

Capacity, Amperes	APPROX. Wt., Lbs.		Style No.	List Price
	Net	Boxed		
5	1	1½	139618	\$16 00
10	1	1½	139619	16 00
20	1	1½	139620	18 00
50	1½	2½	139621	20 00
100	2½	3½	139622	20 00
200	3½	5½	139623	25 00
500	7½	11	139624	32 00
1000	12½	19	139625	42 00
1200	16	22	272948	45 00
1500	19	25	272949	50 00
2000	25	30	272950	60 00
2500	31	38	272951	70 00
3000	38	50	272952	75 00
4000	43	56	272953	100 00
5000	54	70	272954	120 00
6000	63	85	272955	150 00
8000	72	105	272956	200 00



COMBINATION LABORATORY SHUNT

### Combination Laboratory Shunts 100 Millivolts

Capacity, Amperes	APPROX. Wt., Lbs.		Style No.	List Price
	Net	Boxed		
5-20-100	5	7	168094	\$57 50
5-20-200	5	7	185293	68 00
10-50-200	5	7	168095	72 00

### Combination Carrying Case

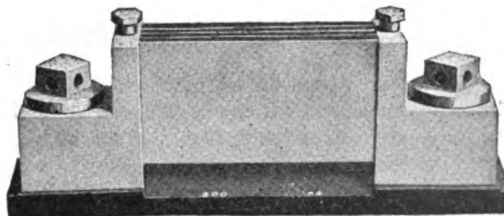
**Combination Carrying Case**—This wooden case has room for one shunt of 1000, 800, or 500 amperes and 5 shunts each 200 amperes or less. Special shunt units without cases are listed for use with this combination carrying case. These shunt units are similar to the regular type PL portable shunts except they are not mounted in a separate box.

Style number and list price include carrying case only.

Description	Style No.	List Price
Carrying Case for Shunts	167587	\$20 00

### Shunt Units for Combination Carrying Case—100 Millivolts

Capacity Amperes	APPROX. Wt., Lbs.		Style No.	List Price
	Net	Boxed		
5	1	1½	167588	\$5 00
10	1	1½	167589	5 00
20	1	1½	167590	5 50
25	1½	1½	167591	6 00
50	1½	2½	167592	8 00
100	2½	3½	167593	12 00
200	3½	5	167594	16 00
500	6	8	167595	25 00
800	8	10	167596	31 00
1000	10	15	167597	35 00

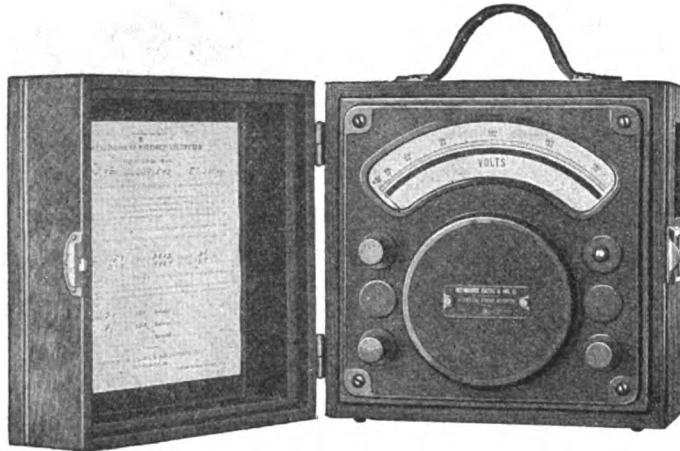


TYPE PL PORTABLE SHUNT UNIT

Order by Style Number

## TYPES PC AND PD PORTABLE INSTRUMENTS

A-C. OR D-C. AMMETERS, VOLTMETERS, AND WATTMETERS  
 IRON LOSS VOLTMETERS, POWER FACTOR METERS  
 FREQUENCY METERS



TYPE PC A-C. OR D-C. VOLTMETER

### Application

These are high-grade direct-reading instruments for general testing and laboratory work where especially high accuracy is desired, particularly on alternating-current.

The permanence of calibration of these instruments, when handled with reasonable care, makes them very desirable as standards for calibrating other instruments, including portable standard watt-hour meters.

Type PC ammeters, voltmeters, wattmeters, and power factor meters operate on the electro-dynamometer principle, and type PD frequency meters on an adaptation of the induction principle. The perfectly damped character of the indications enables readings to be taken quickly and accurately, and makes these instruments very desirable in measuring fluctuating loads.

### Construction

The movement is mounted as a unit and can be

removed complete after taking off the face-plate. The face-plate makes a dust-proof joint with an inner aluminum mounting plate. The moving element is light, but not delicate.

**Cases**—The instruments are mounted in hardwood carrying cases with hinged covers that are easily removed, and have flexible sole-leather handles.

**Damping**—Unexcelled damping features prevent unnecessary wear on the bearings and lessen the effect of rough handling.

**Scale**—The scale covers an arc of 90 degrees, giving large, open divisions. The scale for the wattmeters is wider at the lower end to give high accuracy for the low readings, and for the voltmeters wider at the middle, where readings are most frequently made. A mirror extending the entire length of the scale prevents parallax in reading.

**Finish**—The terminals are finished in bright nickel. The face-plate is of polished black composition, and the case is polished hard wood.

### TYPE PC AMMETERS

Type PC ammeters are entirely self-contained. The main current to be measured passes through two stationary coils and an inductive shunt, all connected in series; the moving coil is connected across the shunt. As the readings of this instrument on commercial frequencies are as accurate as on direct current, it will be found of great value as a "transfer standard."

Style number and list price include instrument complete as described. Made in double capacity only.

Current Ranges, Amperes	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
2½-5	8¼	20	272962	\$145 00
5-10	8¼	20	272963	150 00

Order by Style Number

## TYPES PC AND PD A-C. AND D-C. PORTABLE INSTRUMENTS—Continued

## TYPES PC VOLTMETERS

A contact switch operated by a button on the front of the instrument is provided on each voltmeter. The listed voltmeters are entirely self-contained, all necessary resistors to obtain the calibrated scale readings being contained in the case, which is well ventilated. The double-scale instruments have the terminals plainly marked.

Voltmeters for lower voltages than those listed or with special ranges can be supplied on special order, prices on request.

**Approximate weight:** net, 8½ pounds; boxed, 20 pounds.

Style number and list price include voltmeter complete with internal resistors for the voltage listed.

Scales Volts	Style No.	List Price
0-75	182963	\$100 00
{ 0-75 }		
{ 0-150 }	169518	105 00
{ 0-150 }		
{ 0-300 }	169519	110 00
{ 0-150 }		
{ 0-600 }	272959	115 00
{ 0-300 }		
{ 0-600 }	219315	115 00
{ 0-300 }		
{ 0-750 }	219316	120 00

## TYPE PC POWER FACTOR METERS

The power factor meters are direct reading and operate on the moving coil principle. Two forms are made: for single or two-phase circuits, and for three-phase circuits.

The moving element has two voltage coils fixed at right angles to each other, and the stationary current coils are parallel to the axis of the moving coils. The currents in the voltage coils differ from each other in phase, and depend for their phase relation to the current in the stationary coils, on the phase of the voltage of the circuit. Any difference in phase between the voltage and current of the circuit, therefore, changes the relative torques of the two coils of the moving element, which determines the position that the moving element and pointer will assume. In the single-phase instrument the difference in phase between the currents in the moving coils is produced by a split-phase arrangement, and in the three-phase instruments by connecting to two phases of the circuit.

The single-phase power factor meter can be used on a single-phase circuit or on one phase of a two-

phase circuit, but cannot be used in one phase of a three-phase circuit unless provision is made for obtaining phase relations at the instrument equivalent to the phase relations of current and voltage in a single-phase circuit. It can be calibrated specially for use on three-phase three-wire circuits, but it then becomes essentially a three-phase instrument and cannot be used on single-phase circuits. The instrument has two scales, one for 25 cycles and the other for 60 cycles. The three-phase instruments are suitable for any frequency.

Style number and list price include self-contained power factor meter complete for 5-ampere circuit. For larger capacities a portable current transformer should be used.

These instruments can be used on circuits within 25 per cent below, or 50 per cent above rated voltage.

Frequency, Cycles	Phase	Nominal Voltage	Style No.	List Price
25-60	1*	110	177036	\$125 00
Any	3*	110	177039	110 00

**Approximate Weight**—Net, 9 pounds; shipping, 21 pounds.  
\*For two-phase circuits use single-phase instrument on one phase.

## TYPE PD FREQUENCY METERS

Type PD frequency meters indicate by means of a scale and pointer. They operate on the induction principle, and consist of two voltmeter electromagnets acting in opposition on a disk attached to the pointer shaft. One of the magnets is in series with a resistor, and the other with an inductor, so that any change in the frequency will unbalance the forces acting on the shaft and cause the pointer to assume a new position, where the forces are again balanced. The aluminum disk, acted upon by the magnets, is so shaped that, when the shaft turns, the torque due to one magnet varies, while the torque due to the other magnet remains constant. The pointer therefore comes to rest where the torques of the two magnets are equal. This arrangement

insures freedom from error, due to varying voltage. The scale is calibrated to indicate the number of cycles directly.

The instruments contain no moving wires, moving iron, or vibrating reeds, and no controlling springs. The controlling forces are entirely electrical, and thus the calibration is permanent.

Style number and list price include self-contained frequency meter complete for 90 to 130-volt circuits. For other voltages, a portable transformer having 100-volt secondary should be used.

Frequency	Voltage	Style No.	List Price
20 to 45	90-130	177034	\$100 00
45 to 75	90-130	177035	100 00

**Approximate Weight**—Net, 9 pounds; shipping, 21 pounds.

Order by Style Number

TYPES PC AND PD A-C. AND D-C. PORTABLE INSTRUMENTS—Continued

TYPE PC WATTMETERS



TYPE PC A-C. OR D-C. WATTMETER

The listed wattmeters are entirely self-contained, all resistors necessary for the rated voltage ranges being contained in the case. The wattmeters that have double current or double voltage range are provided with a switch operated by a knob on the face-plate, which makes series or parallel connection of coils when the knob is turned to the proper position. Only two current and two voltage binding posts are, therefore, necessary. Special instruments can be supplied with sufficient overload capacity to give full scale deflection on 20 per cent power factor.

The polyphase wattmeter when properly connected, indicates the true power in a two-phase three wire or four-wire,\* or a three-phase three-wire or four-wire circuit. They are useful in polyphase testing, as one instrument indicates the total power and it is not necessary to take separate readings in two phases and add or subtract them. They can be used for single-phase as well as polyphase testing, either by connecting only one element in circuit or by connecting the two current coils in series and the two voltage coils in multiple on the single-phase line. With the latter connection, the instrument reads twice the actual load. If transformers are required, the polyphase instrument connected single-phase operates from the same transformers that would be used with a single-phase instrument.

Style number and list price include self-contained wattmeter complete.

Type PC Single-Phase Wattmeters

Maximum Voltage	Current Capacity, Amperes	Scales	Style No.	List Price
150	1	100 W.	182972	\$140 00
300	2	200 W.		
		400 W.		
150	2 5	250 W.	182973	140 00
300	5	500 W.		
		1000 W.		
150	5	500 W.	182974	145 00
300	10	1000 W.		
		2000 W.		
150	10	1000 W.	182975	150 00
300	20	2000 W.		
		4000 W.		
150	20	2 kw.	182976	160 00
300	40	4 kw.		
		8 kw.		
150	30	3 kw.	182977	160 00
300	60	6 kw.		
		12 kw.		
150	5	500 W.	272960	160 00
600	10	1000 W.		
		2500 W.		
300	5	5000 W.	219313	160 00
600	10	1000 W.		
		2000 W.		
		4000 W.		

Type PC Polyphase Wattmeters

Max. Voltage	Amp. per Phase	Scales	Style No.	List Price
150	2.5	500 W.	196555	\$210 00
300	5	1000 W.		
		2000 W.		
150	5	1000 W.	196666	210 00
300	10	2000 W.		
		4000 W.		
150	5	1000 W.	272961	225 00
600	10	2000 W.		
		5000 W.		
300	5	10000 W.	219314	225 00
600	10	2 kw.		
		4 kw.		
		8 kw.		

Approximate Weight—Single-phase: net, 9 pounds; boxed, 20 pounds; polyphase: net, 14 pounds; boxed, 30 pounds.

\*When used on interconnected two-phase four-wire circuits, these instruments require two voltage transformers for any voltages as there are only three voltage terminals, one being common to each element. The transformers are necessary for the purpose of insulating the two-voltage circuits from the main conductors so that the common connection can be made at the instruments. Special polyphase wattmeters arranged for direct connections to all phases without transformers (within capacity) can be supplied for use on two-phase circuits, prices of which will be given on request; two standard single-phase instruments can also be used.

Order by Style Number

TYPES PC AND PD A-C. AND D-C. PORTABLE INSTRUMENTS—Continued

TYPE PC IRON-LOSS VOLTMETER

This instrument is for use with a wattmeter for determining the iron loss in distributing and power transformers on the basis of sine wave voltage and normal frequency, when the testing is done on a circuit of any wave shape and approximately normal frequency.

The iron loss in a transformer varies with the wave shape and frequency. Guarantees are, therefore, based on sine wave and a normal frequency; but the standard conditions are difficult to obtain in practice.

The iron-loss voltmeter consists of a type PC wattmeter movement connected in series with the winding on an iron core, and so compensated that it measures the iron loss in the core. It is calibrated in "volts" on a circuit of pure sine wave voltage. Any circuit that makes the instrument read a certain "voltage," therefore, produces the same iron loss as would a pure sine wave of that voltage. The instrument does not indicate the voltage of the circuit, but the voltage of a pure sine wave of normal frequency that would cause the same iron loss in the transformer as the wave of voltage of the testing circuit.

In application the iron-loss voltmeter is connected across the terminals of the transformer under test in the same manner as an ordinary voltmeter. A wattmeter is also connected in the circuit in such a way as to measure the total input of both the transformer and the iron-loss voltmeter. The voltage of the circuit is then adjusted by any convenient means until the iron-loss voltmeter reads the normal voltage of the transformer. The total power input is read on the wattmeter and the watts input of the



TYPE PC IRON-LOSS VOLTMETER

iron-loss voltmeter is read on its watt scale, the difference being the normal iron loss of the transformer.

Style number and list price include complete instrument.

Voltage	Frequency Cycles	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
125-250	60	20	50	185074	\$200 00

RESISTORS\* FOR VOLTMETERS, WATTMETERS, AND THREE-PHASE POWER FACTOR METERS

Resistors are listed that adapt any of the voltmeters or wattmeters for use on voltages up to 600, and the three-phase power factor meters for voltages up to 400. Above these voltages and for single-phase power factor meters on voltages above 150,

voltage transformers should be used when measuring alternating current. For voltmeters that are to be used on direct-current circuits of higher voltages, special resistors can be furnished.

Rated Ohms	For Voltmeter Style No.	For Wattmeter Style No.	For Power Factor Meter Style No.	CHANGES From	VOLTAGE To	Style No.	List Price
{ 550 } { 1650 }	182963	.....	.....	0- 75	{ 0-150 } { 0-300 }	207389	\$34 00
{ 1100 } { 3300 }	169518	.....	.....	0-150	{ 0-300 } { 0-600 }	207390	42 00
{ 2000 } { 6000 }	.....	{ 169520 to 169526 } { 182965 to 182970 }	.....	150	{ 300 } { 600 }	182971	34 00
4000	169519	{ 169527 to 169533 } { 182972 to 182977 }	.....	300	600	207391	28 00
{ 2000 } { 2000 }	.....	.....	177039	100	200	†207392	38 00
{ 4000 } { 4000 }	.....	{ 198555 to 198556 } { ..... }	177037 or 177039	300 100	{ 600 } { 300 }	†178554	42 00

\*These resistors are not interchangeable; each must be adjusted for the particular instrument with which it is used. When ordering new resistors for instrument already in service state the exact resistance of instrument. A record of the original resistance will be found on the instruction card in cover. If the instrument has never been readjusted and is in good condition this information can be copied from card.

†This resistor includes two separate 2000 ohm resistors in one box.

‡This resistor includes two separate 4000 ohm resistors in one box.

Order by Style Number

TYPES PC AND PD A-C. AND D-C. PORTABLE INSTRUMENTS—Continued

**Transformers**—For voltages or currents higher than those for which instruments are listed, instruments for 100 volts and for 5 amperes should be used with voltage and current transformers selected from the pages of this catalogue on "Instrument Transformers."

It is strongly recommended that all shipments of portable instruments be made by express and they will be so shipped in all cases where method of shipment is not specified by the purchaser. Where the purchaser specifies shipment by freight the Westinghouse Company will accept no responsibility for errors found in calibration.

**Transportation of Portable Instruments**

Experience has shown that portable instruments shipped by freight are subjected to such rough handling that there is an appreciable tendency toward change in calibration or actual damage.

**Over-All Dimensions—Inches**

Type PC Voltmeter.....	7 3/4 x 7 3/4 x 6 1/4
Type PC Wattmeter (Single-Phase).....	7 3/4 x 7 3/4 x 6 1/4
Type PC Wattmeter (Polyphase).....	7 3/4 x 7 3/4 x 9 1/2
Type PC Iron Loss Voltmeter.....	7 3/4 x 7 3/4 x 12
Type PC Power Factor Meter.....	7 3/4 x 7 3/4 x 6 1/4
Type PD Frequency Meter.....	7 3/4 x 7 3/4 x 6 1/4

**Special PC Instruments**—Milliammeters, capacity meters, compensated wattmeters, special wattmeters for very low power factor testing, and ranges not listed in voltmeters, ammeters, wattmeters, and frequency meters can be furnished. Prices on request.

TABLE OF SCALE MARKINGS - TYPES PC AND PD METERS

Style No.	Capacity	Divisions			Marking								
		Main	Int.	Sub-Total									
<i>Type PC Voltmeters</i>													
182963	75 Volts	15	2	5	150	0	10	20	30	40	50	60	70
169518	75-150 Volts	15	2	5	150	0	20	40	60	80	100	120	140
169519	150-300 "	15	2	5	150	0	40	80	120	160	200	240	280
<i>Type PC Wattmeters</i>													
169520	100 Watts	10	2	5	100	0	20	40	60	80	100		
169521	200 "	10	2	5	100	0	40	80	120	160	200		
169522	100-200 "	10	2	5	100	0	40	80	120	160	200		
169528	400 "	8	2	5	80	0	100	200	300	400			
182972	100-200-400 Watts	10	2	5	100	0	80	160	240	320	400		
169522	500 Watts	10	2	5	100	0	100	200	300	400	500		
182966	250-500 "	10	2	5	100	0	100	200	300	400	500		
169523	1000 "	10	2	5	100	0	50	100	150	200	250		
169529	1000 "	10	2	5	100	0	200	400	600	800	1000		
182967	500-1000 "	10	2	5	100	0	200	400	600	800	1000		
182973	250-500-1000 Watts	10	2	5	100	0	100	200	300	400	500		
169530	2000 Watts	10	2	5	100	0	50	100	150	200	250		
182968	1000-2000 "	10	2	5	100	0	400	800	1200	1600	2000		
182974	500-1000-2000 Watts	10	2	5	100	0	200	400	600	800	1000		
186555	500-1000-2000 Watts	10	2	5	100	0	100	200	300	400	500		
169524	2500 Watts	10	2	5	100	0	500	1000	1500	2000	2500		
182969	2000-4000 "	8	2	5	80	0	1000	2000	3000	4000			
182975	1000-2000-4000 Watts	10	2	5	100	0	800	1600	2400	3200	4000		
186556	1000-2000-4000 Watts	10	2	5	100	0	400	800	1200	1600	2000		
186557	1000-2000-4000 Watts	10	2	5	100	0	200	400	600	800	1000		
186558	5 Kw.	10	2	5	100	0	1	2	3	4	5		
182970	3-6 "	12	2	5	120	0	.5	1	1.5	2	2.5	3	3.5
182976	2-4-8 "	8	2	5	80	0	2	4	6	8			
218314	2-4-8 "	8	2	5	80	0	.5	1	1.5	2	2.5	3	3.5
169526	10 "	10	2	5	100	0	2	4	6	8	10		
169532	10 "	10	2	5	100	0	2	4	6	8	10		
182977	3-6-12 "	12	2	5	120	0	1	2	3	4	5	6	7
169533	20 "	10	2	5	100	0	.5	1	1.5	2	2.5	3	3.5
<i>Type PC Iron Loss Voltmeter</i>													
185074	125-250 Volts	12 1/2	2	5	125	0	40	80	120	160	200	240	280
<i>Type PD Frequency Meters</i>													
177034	20 to 45 Cycles	5	5	5	125	20	25	30	35	40	45		
177035	45 to 75 "	6	5	5	150	45	50	55	60	65	70	75	

## TYPES PM AND PR PORTABLE AMMETERS FOR ALTERNATING-CURRENT CIRCUITS



TYPE PM AMMETER

### Application

These are direct-reading instruments for general alternating-current testing and laboratory work. Exceptionally long, open scales, and perfectly damped character of the indications, enable readings to be taken quickly and accurately, and make these instruments very desirable for measuring fluctuating loads or for general testing.

### Distinctive Features

Permanent accuracy, light but strong moving element, high torque, no moving wires or connections, freedom from effects of external fields,

damping by permanent magnets, and excellent readability.

Compared to moving-iron instruments, these instruments offer many advantages such as freedom from stray fields, and longer scales. The long scales permit of fewer instruments for a complete equipment for any given range of testing.

### Operation

These instruments operate on the induction principle. Simple construction and accessibility of all parts have been made prime features in their designs.

## TYPE PM INSTRUMENTS

### Construction

**Case and Cover**—Mounted in polished wood carrying cases with hinged covers, which are easily removed, and with flexible sole-leather handles. By withdrawing four screws and removing a connection strap on the face-plate the sides and face of the case can be removed, leaving the measuring element mounted on the base in good position for inspection or repairs.

**Scales**—Scale subtends an arc of 240 degrees, giving large, open divisions that are clearly readable from 10 per cent to full scale. Mirror extending the entire length of the scale prevents parallax in reading.

**Simplicity**—The use of the induction principle results in a very simple construction. The moving element is light but not delicate.

**Damping**—Perfect damping is obtained with minimum weight of movement. A sudden application of full load will not cause the pointer to overswing. In addition, heavy damping has the effect of preventing mechanical shocks and unnecessary wear on the bearings.

**Accuracy and Permanence**—The exceptionally high torque developed makes these instruments extremely sensitive to permanent changes in load as distinguished from momentary fluctuations, which are damped out. They are not affected by temperature changes, and a curve accompanying each instrument gives corrections for frequencies between 20 and 65 cycles. The absence of pivot wear, insured by the light moving element and the design and materials used in the bearings, enables the instruments to retain their high initial accuracy for a long period of service.

## TYPES PM AND PR A-C. PORTABLE AMMETERS—Continued

**Torque and Weight of Movement**—Extremes of weight in the movements have been avoided. The ratio of torque to weight is exceedingly high.

**Finish**—The terminals and connection straps are finished in bright nickel. Metal parts close to the dial are finished in black nickel to avoid glare. The face-plate is of polished black composition.

**Size**—The cases of the type PM ammeters are 6¾ inches by 7¾ inches by 4¾ inches high.

**Range in Calibration**—Each instrument has two scales with a ratio of 1 to 2, and the calibration is equally correct for either scale.

## Scale Marking

The scale marking is so divided that the division marks give even readings. Thus, the 40-ampere instrument has eight main divisions, five intermediate divisions, and four sub-divisions, or a total of 160 divisions; each sub-division is .25 ampere. Owing to the condensation of the scales at the zero end, a number of the sub-divisions are omitted, usually about 10 per cent. The main (numbered) divisions of the scale are, however, given down to zero.

## Type PM Ammeters

**Style number and list price** include self-contained instrument in a polished box with removable cover. Style Nos. 169511 and 169512 may be used in con-

nection with current transformers having 5 amperes secondary current for full-scale deflection.

Current Ranges, Amperes	Frequency Cycles	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
0-1 and 0-2	20 to 65	8	20	169510	\$75 00
0-2½ and 0-5	20 to 65	8	20	169511	75 00
0-5 and 0-10	20 to 65	8	20	169512	75 00
0-10 and 0-20	20 to 65	8	20	169513	80 00
0-20 and 0-40	20 to 65	8	20	169514	85 00
0-30 and 0-60	20 to 65	8	20	169515	85 00
0-40 and 0-80	20 to 65	8	20	169516	90 00
0-60 and 0-120	20 to 65	8	20	169517	90 00

## TYPE PR INSTRUMENTS

The type PR ammeters fill the demand for instruments where low first cost is of more importance than very high accuracy. The mechanism is similar to that of the type PM, the difference consisting in the omission from type PR of some of the refinements. The main differences are: pivots permanently attached to movement instead of removable; cases made from cast aluminum, black japanned finish, without hinged cover, not sealed.

**Size**—The cases of the type PR ammeters are 6 inches by 7 inches by 3¾ inches.



TYPE PR AMMETER

## Type PR Ammeters

**Style number and list price** include self-contained instrument in metal case without cover. Style No. 172569 may be used in connection with current transformers having 5-ampere secondary current for full scale deflection.

Full Scale Capacity, Amperes	Frequency, Cycles	APPROXIMATE WT., LBS.		Style No.	List Price
		Net	Boxed		
As desired	25 to 60	7¾	11	172569	\$45 00
5	25 to 60	7¾	11	219146	45 00
10	25 to 60	7¾	11	219147	45 00

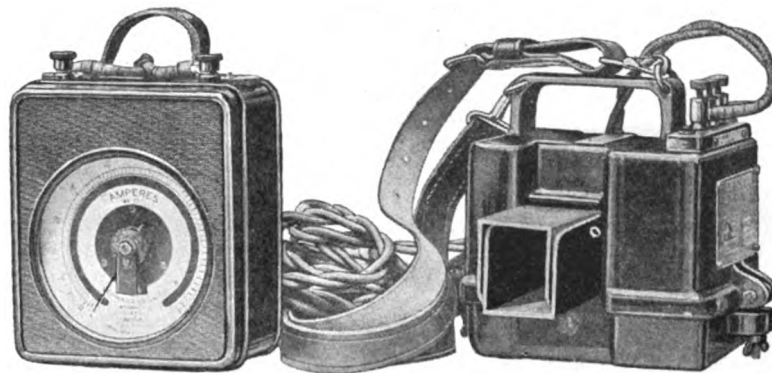
For transformers for use with these instruments see pages on "Portable and Switchboard Current and Voltage Transformers."

Order by Style Number



## TYPES PM AND PR A-C. PORTABLE AMMETERS—Continued

## TYPE PR PORTABLE TESTING OUTFITS



TYPE PR PORTABLE TESTING OUTFIT

**Application**

These outfits provide a convenient means of measuring currents from 75 amperes up to 250 amperes in an overhead line or in station wiring without opening the circuit. These values are lower than could be measured with a standard instrument and split-type transformer.

**Construction**

The outfit consists of a portable split-type current transformer, Style No. 117508, a type PR portable ammeter, a set of leads 10 feet long and a leather carrying strap.

The split-type current transformer is made with a clamp at one side and a hinged joint at the other so that the two halves can be opened, slipped over the cable, and clamped together tightly. By means of binding posts on the transformer, connec-

tions can be made for obtaining full scale readings on either 125 or 250 amperes primary.

**Insulation**—The split-type current transformer is insulated for use on 2300-volt circuits, it being assumed that for higher voltages they will be used over cable having sufficient insulation for the protection of the operator and instrument.

**Accuracy**

The transformer and instrument are calibrated together so that fairly accurate readings are made without corrections. The transformer is not suitable for use with a wattmeter or watthour meter and cannot be used with an ammeter that has not been calibrated with it. The ammeter as included in the set cannot be used alone or with any transformer other than the one with which it is calibrated.

**Style number and list price** include type PR ammeter, portable transformer Style No. 117508, leads 10 feet long, and leather carrying strap.

Frequency, Cycles	Full Scale Capacity, Amperes	Opening for Conductor Inches	APPROXIMATE Wt., LBS.		Style No.	List Price
			Net	Shipping		
60	125 or 250	1 3/4 x 1 1/4	28 1/4	48	172571	\$110 00

*Order by Style Number*

## PRECISION INSTRUMENTS FOR A-C. OR D-C. CIRCUITS



STYLE No. 35248, VOLTMETER



STYLE No. 35243, AMMETER

### Application

These instruments are for use as calibration standards for watt-hour meters, switchboard and portable instruments, and for general laboratory work. They possess the highest degree of accuracy compatible with portability and simplicity of mechanical and electrical features. With them it is possible to make rapid and accurate measurements on both alternating-current and direct-current work.

### Operation

These instruments operate on the principle of the Kelvin Balance, the mechanical construction being suitably modified to render them portable and to obviate the necessity for accurate leveling. The stationary and moving coils of the measuring element are astatically arranged. The frictional factor is practically eliminated by supporting the movable coils on a ball-bearing consisting of a highly polished steel ball seated between two cupped sapphire jewels.

### Scales and Adjustments

These instruments are of the zero reading type, the index pointer indicating zero when the deflecting pointer indicates the value of electrical quantity. Approximate adjustment of the deflecting pointer may be made by the knurled head on top, and final adjustment accurately secured through a continuous worm operated by the adjusting rod and thumb screw at the side.

The scales are graduated on a silvered dial, with

large and open divisions, which form equal parts of the entire circumference of a circle about 5 inches in diameter.

The ammeter and voltmeter deflections are proportional to the square of the quantity measured. The wattmeter deflections are directly proportional to the watts in the circuit. The voltmeters and ammeters are provided with two scales, one divided into equal divisions which may be read with a vernier, the other divided into divisions proportional to the square root of the deflection and hence proportional to the voltage or current. The latter scale is used for taking readings when only ordinary accuracy is necessary. For extreme accuracy readings are taken on the evenly divided scale and the square root obtained from a table furnished with the instrument and this multiplied by the constant. With 1000 ohms in the potential circuit of the voltmeter this constant is 10, thus reducing the amount of calibration necessary to a minimum.

These instruments are calibrated in the standardizing laboratory of the Westinghouse Electric & Mfg. Company, and a certificate furnished with each instrument gives the various constants and the calibration curve of the instrument.

**Recalibration**—The Westinghouse Electric & Mfg. Company will check these instruments for a period of five years from the date of original purchase without any expense to the purchaser, except the transportation charges.

### PRECISION AMMETERS

Precision ammeters are applicable to cases requiring a greater accuracy than that of the usual type of portable ammeter or dynamometer. Ammeters listed are self-contained.

Maximum Current Capacity	Style No.	List Price
1 ampere	35242	\$310 00
5 amperes	35243	310 00
10 amperes	35244	310 00
2.5-5 amperes	60180	360 00

Order by Style Number

PRECISION INSTRUMENTS—Continued

PRECISION VOLTMETERS

Each voltmeter outfit consists of a low reading milliammeter, used in connection with a known resistance. The instrument will give full scale deflection on 0.15 of an ampere, and has a resistance of exactly 100 ohms. Therefore, when used with external resistor, Style No. 35249, it will measure

up to 150 volts, and to proportionate voltages with other resistors.

Style number and list price do not include external resistor. External resistors must be used for all voltages.

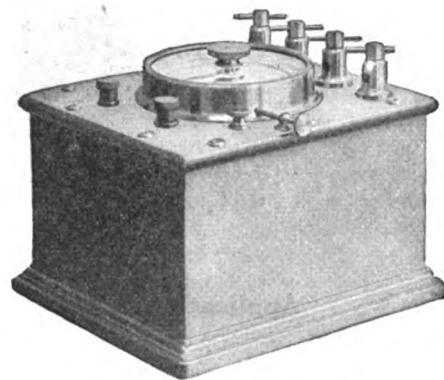
Scale	Style No.	List Price
150 volts	35248	\$310 00

PRECISION WATTMETERS

**Resistance**—The resistance of the potential coil in these instruments is exactly 100 ohms, and they may be used with suitable external resistance on potentials up to 2500 volts.

**Range**—For use in calibrating watt-hour meters, Style No. 35241 is furnished covering three current-ranges of a maximum capacity of 5, 20 and 100 amperes. With 1000 ohms in the potential circuit, and 100 volts on a non-inductive load this instrument will give full scale deflections on 2.5, 20 or 100 amperes. To obtain the maximum capacity of the 5-ampere coil on 100-volt circuits, an external resistance of 2000 ohms should be used. With a resistance in the potential circuit for 100 volts these instruments will accurately measure quantities ranging from 10 to 10,000 watts and proportionate values at other voltages.

Style number and list price do not include external resistors, which must be used for all voltages, except Style No. 66371, which is self-contained for 150-300 volts.



STYLE No. 35241, WATTMETER

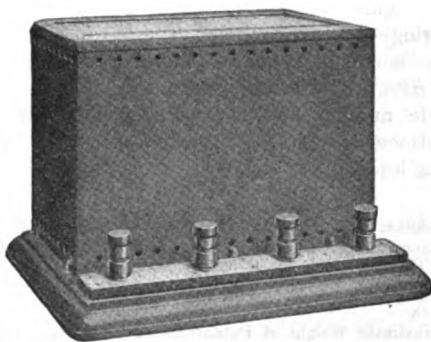
Style No. 66371 is a self-contained instrument. The current coils are similar to those in Style No. 35241, but it has in addition a resistance of 2000 ohms total mounted on the outside of the case, making the resistor and instrument a single unit.

Maximum Current Capacity	Style No.	List Price
2.5-10-50 amperes	54973	\$515 00
5-20-100 amperes	35241	515 00
5-20-100 amperes self-contained	66371	575 00

RESISTORS FOR PRECISION VOLTMETERS AND WATTMETERS

The precision resistors are for use with precision voltmeters and the potential circuits of precision

wattmeters. Up to and including the 6000 ohm size, they are made up in several sections giving steps of 1000 ohms each, which is the value used for a normal potential of 100 volts.



STYLE No. 35250, RESISTOR

**Sub-Division**—The first section of each box has a sub-division of 100 ohms to allow for the resistance of the instrument coils, the total resistance being used when the boxes are connected in series.

Resistance Ohms	Sections Ohms	Normal Working Voltages For Total Resist-		Style No.	List Price
		ance			
1000	100-900	100		35249	\$105 00
2000	100-900-1000	200		35250	145 00
4000	100-900-1000-2000	400		35251	205 00
6000	100-900-1000-2000-2000	600		35252	260 00

Order by Style Number

## PORTABLE POTENTIOMETERS

### FOR "HOT SPOT" TEMPERATURE MEASUREMENTS



#### Application

Portable potentiometers have the same application as the switchboard potentiometers listed on another page, except arranged for portable service. They are the most accurate means of measuring the temperature of the hottest parts in electrical machines.

**Industrial Uses**—The potentiometer is coming into wide use for measuring temperatures in other than electrical apparatus. With the thermo-couples embedded in bales of cotton or tobacco in course of curing, in storage coal piles, and in similar places, the temperature of the interior of the piles can be determined without disturbing them. The portable instrument lends itself especially to these industrial applications because it is not often convenient to carry the leads from such location to a central point at which the switchboard instrument could be mounted.

**As a Millivoltmeter**—The potentiometer is calibrated in millivolts as well as in degrees and can therefore be used within its capacity as a millivoltmeter. As it operates on the slide-wire-potentiometer principle, with proper connections it can be used for any testing for which the slide-wire-potentiometer can be used.

#### Distinctive Features

Readings are made directly in degrees; couples are simple, inexpensive, and mechanically strong; there is no appreciable time lag in making measurements; there are no errors due to change of resistance.

#### Construction

The portable potentiometer is essentially the same as the switchboard instrument described on another page.

**Case**—The potentiometer is mounted in polished hardwood case with hinged cover that is removed easily, and has a flexible sole-leather handle. Size of case: 11 inches wide by 11 inches long; 6 inches high.

**Wiring**—All wiring from the couples to the potentiometer must consist of one copper wire and one "advance" (nickel-copper) alloy wire.

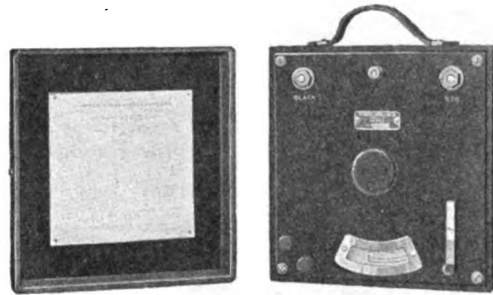
**Style number and list price** include portable potentiometer complete with one test thermo-couple having leads 6 feet long.

Description	Tempera- ture Range, Degrees C.	Milli- volt Range	Style No.	List Price
Potentiometer	0-200	8.4	306280	\$250 00
Extra Thermo-Couple, including 6 feet of leads and terminal clips			232014	3 50
Additional leads, per foot additional length			.....	25

**Approximate Weight of Potentiometer**—Net, 8½ pounds, boxed, 20 pounds.

*Order by Style Number*

## PORTABLE FAULT LOCALIZERS



PORTABLE FAULT LOCALIZER WITHOUT GALVANOMETER

The portable fault localizer is used for locating grounds in a power feeder. It is an application of the Wheatstone bridge with all the necessary apparatus contained in one portable case wired for connection to the circuit to be tested.

Its use assumes that the cable is grounded at only one point and that a parallel conductor of the same length and resistance as the faulty cable is available.

**Operation**—After all electrical connections to the defective feeder have been removed and before the fault localizer has been connected to the cable, the cable is tested by means of a temporary connection through a lamp bank or battery for the grounded conductor. If the lamps do not burn brightly, a high resistance ground is indicated and should be broken down by applying a sufficiently high voltage.

The fault localizer is connected as shown in the diagram, and the dial revolved by means of the knob in the middle of the localizer until the galvanometer does not show any deflection when the key is closed. The reading of the instrument then shows the per cent of length of the feeder from the point where the test is being made to the location of the ground, assuming the total length of the feeder to be 100 per cent; the red scale indicating that the ground is on the conductor connected to the binding post marked red, and the black scale indicating to the binding post marked black.

Direct-current only is used in these tests.

**Advantages**—Ease of adjustment; position of the ground read directly off the dial in terms of per cent of length of defective cable.

**Construction**—The fault localizer consists of a polished wooden case which contains all the parts necessary for the test except the source of direct-current supply, the lamp bank or other load, and the leads to the cables. Style No. 214185, however, does not have the galvanometer or galvanometer leads, and is listed for use with a separate galvanometer.

**Galvanometer**—Galvanometer, Style No. 311818, which is also supplied with fault localizer Style No. 216718 is a highly sensitive galvanometer which does not require to be leveled to take readings. It can be used for general testing wherever a portable galvanometer of its sensibility is desired.

The following are its constants:

Resistance—19 ohms.

Sensibility—.001 amperes per division.

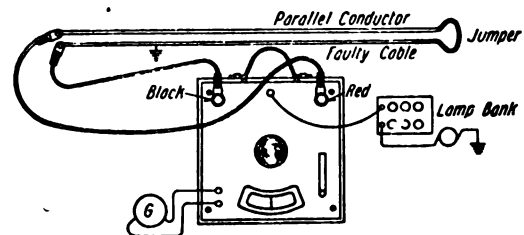


DIAGRAM OF CONNECTIONS

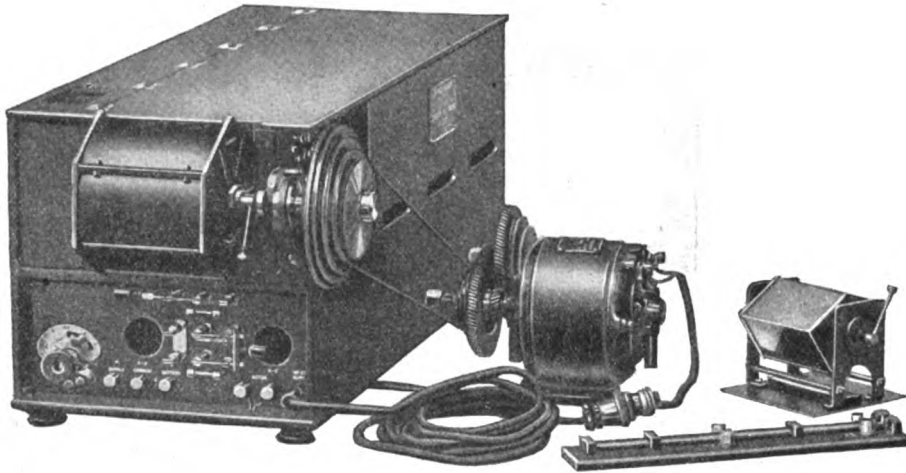
### PRICES

Style number and list price include the fault localizer complete as described.

Style No.	Description	Approx. Overall Dimensions Inches	APPROX. WT., LBS.		List Price
			Net	Shipping	
214185	Without galvanometer	9 $\frac{1}{2}$ x10 $\frac{1}{2}$ x3 $\frac{3}{4}$	5	12	\$100 00
216718	With galvanometer and leads	14 $\frac{1}{2}$ x10 $\frac{1}{2}$ x3 $\frac{3}{4}$	9	15	115 00
311818	Galvanometer only, Type PX-2	3 $\frac{1}{2}$ x 3 $\frac{1}{2}$ x1 $\frac{1}{2}$	2	3	18 00

Order by Style Number

## PORTABLE THREE-ELEMENT OSCILLOGRAPH



GENERAL ASSEMBLY VIEW WITH MOTOR AND FILM HOLDER ATTACHED

### Application

Rapid strides in electrical advancement have been made possible by the help of the oscillograph. With the expanding field of electric railways, great interconnected power systems, electrically driven submarines and electrically equipped aeroplanes, there is increased need for an oscillograph outfit which is readily portable and which will work equally well in an aeroplane or in a perfectly equipped laboratory. Such an instrument was thought impossible a few years ago when literally a ton of apparatus was required to carry on an oscillograph test where no suitable direct-current supply was available.

This oscillograph is complete in one unit except for the motor and film holder. It is extremely compact and portable and in addition it will cover a broader field of work and is more easily operated than its predecessors.

### Construction

This main unit is 11 inches wide, 11½ inches high and 25 inches long; and includes: the entire optical system; special incandescent-lamp illuminant; highly sensitive 3 element galvanometer; complete control equipment for vibrator-elements (including 30,300 ohms of non-inductive resistors); transformer (for operating lamp and motor) for 110 or 220 volts supply, at any frequency from 25 to 70 cycles.

The special lamp-control switch and automatic lamp-extinguishing switch enables the operator to apply a greatly abnormal voltage to the incandescent lamp so as to obtain results equal to that formerly obtained only with the intense light of the electric arc. With the automatic features of this instrument, the same lamp may be used for hundreds and even

thousands of oscillograms as the lamp is at great abnormal voltage only for a small fraction of a second, during the exposure.

The latest form of galvanometer is equipped with supermagnets of a newly developed permanent type. These make the vibrators more sensitive than with any previous electro-magnets, with their necessary supply of direct-current. Hence, with this new construction, both the instrument and the operator are relieved of field-rheostat, ammeter, control switches, storage battery, and rectifier.

The special back-gear induction motor has step pulleys which give a great speed range for the photographic film.

The outfit also includes a special film-holder which may be loaded and unloaded without resort to a dark room. This takes standard kodak films which also may be developed without a dark room by using a tank developing outfit.

Even for laboratory use, this outfit has many advantages. Its ease of manipulation and reliability of results is in itself an advantage but its perfect control of the commercial apparatus to be tested makes it practically as easy to take transient phenomena as to take ordinary recurrent a-c. phenomena.

The remote control switch is used to start the mechanical action of remote controlled apparatus, a sufficient time before the opening of the shutter so that the actual start of the electrical phenomena will occur shortly after the exposure begins on the film.

It may be desirable to have the oscillograph operate automatically to record the opening of a large oil breaker under a chance short circuit.

## PORTABLE THREE-ELEMENT OSCILLOGRAPH—Continued

Several portable oscillographs may be operated simultaneously to show different phases of the same transient. These oscillographs may be located on the same table or they may be scattered in different towns or different sub-stations along the same net-work of power lines. Each oscillograph can be set for semi-automatic operation so that when the

operator (at one station) closes in the common supply switch, all the oscillograph motors, lamps, shutters, etc., operate simultaneously.

The main unit weighs but eighty pounds (80 lbs.) complete, and the whole outfit together weighs scarcely more than one hundred pounds.

## TABLE OF APPROXIMATE FILM SPEEDS

For  $4\frac{3}{4}$  Inch Drum

Driving Pulley	Belt Position	25 CYCLE OPERATION		60 CYCLE OPERATION		Total Cycles per 10 Inches
		Rpm.	Seconds/Inch	Rpm.	Seconds/Inch	
Direct	1st	685	0.006	Too Fast	Danger	1.5
Direct	2nd	410	0.010	1010	0.004	2.5
Direct	3rd	230	0.018	570	0.007	4.4
Direct	4th	98	0.042	243	0.017	10.2
Geared	1st	43	0.095	107	0.038	23.
Geared	2nd	25.5	0.160	63.2	0.065	39.
Geared	3rd	14.3	0.286	35.5	0.115	70
Geared	4th	6.1	0.675	15.1	0.272	160.

## Approximate Sensitivity of Vibrator

Standard: 0.11 amperes d-c., per inch deflection (0.044 amperes per centimeter).

Super-sensitive: 0.025 ampere, d-c., per inch deflection. (0.010 amperes per centimeter).

## Approximate Natural Period of Vibration (Undamped)

Standard: 5000 complete cycles per second.

Super-sensitive: 2,500 complete cycles per second.

Required Supply—

To operate lamp and motor on a-c.

110 or 220 volts at 25, 50 or 60 cycles. 250 watts.

To operate lamp and special motor on battery:

One large 6 volt or 12 volt storage battery.

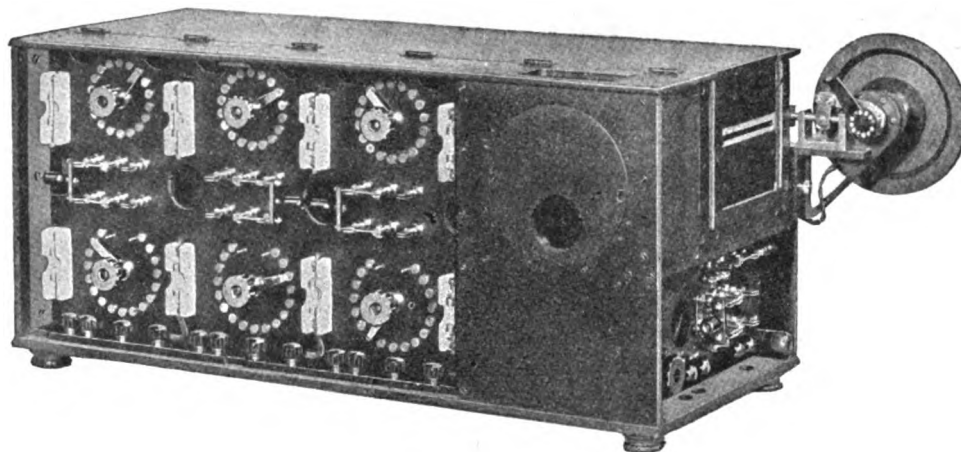
Normal Film Speed Range.

One half inch per second to 260 inches per second (1300 feet per minute).

## PRICES

## STANDARD EQUIPMENT

- (a) Main oscillograph case (11 x 11 $\frac{1}{2}$  x 25 inches) inc.:
- Three element galvanometer with vibrators.
  - Supply panels with switches and fuses.
  - Optical system.
  - Incandescent lamp with control switch and automatic extinguisher.
  - Photographic shutter and control.
  - Remote control mechanism.
  - Driving head for films and mirrors.



ELEMENT CONTROL SIDE OF OSCILLOGRAPH

**PORTABLE THREE ELEMENT OSCILLOGRAPH—Continued**

Element resistances (30,300 ohms) and dial switches.

Transformer for supplying:

Lamp, motor and trip magnet.

Diagram of connections, with key, moulded into panel.

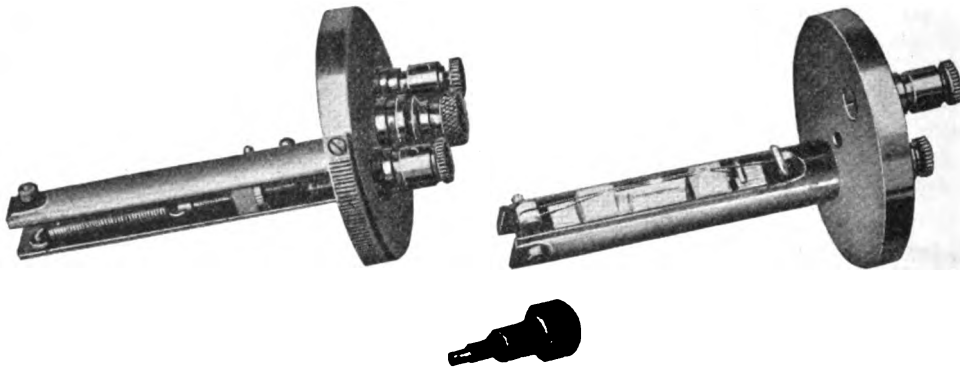
- (b) Back geared induction motor with step pulleys for driving photographic film and viewing mirrors.
- (c) Daylight loading film attachment for taking 5 inch or 10 inch oscillograms.
- (d) Rotating viewing mirrors with ground glass calibration window.
- (e) Three non-inductive shunts for currents from 2 to 20 amperes.
- (f) Spare lamps, fuses, films and repair vibrator parts.

Portable Three-Element Oscillograph (Standard Equipment)..... **List Price \$3675 00**

**SPECIAL EQUIPMENT**

The following special equipment may be had in addition to the standard equipment. Prices of special equipment will be furnished on request.

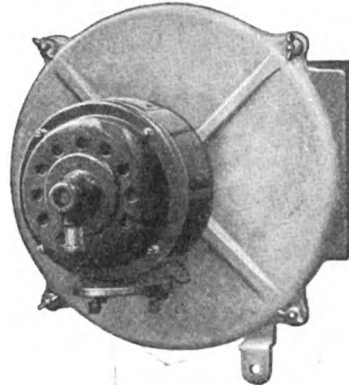
- (a) Small six-volt motor for battery operation.
- (b) Slow-speed long-film attachment.
- (c) Variable, non-inductive shunt—  
20 to 1000 amperes continuous capacity.
- (d) Polar (circular) film attachment with synchronous motor.
- (e) Harmonic analyzer for polar films.
- (f) Oscillograph table for laboratory use.
- (g) Special super-sensitive vibrator element.
- (h) Special case for carrying oscillograph on pullman.
- (i) Additional external resistance unit for use when making records on high voltage d-c. lines.
- (j) Contactor to act as relay for large remote control apparatus. Style No. 300947.



**FRONT AND REAR VIEW OF STANDARD VIBRATOR ELEMENT**



## CIRCULAR-OSCILLOGRAM ATTACHMENT



CIRCULAR-OSCILLOGRAM ATTACHMENT

### Application

This attachment is adapted for use with the standard oscillograph for obtaining circular oscillograms. By a very slight remodeling of the standard oscillograph, the attachment can be used interchangeably with the regular rectangular film-holder, enabling the operator to take rectangular or circular oscillograms at will.

**Use of Circular-Oscillograms**—When electrical investigations and calculations are to be made of a periodic function, they can generally be simplified and are often more accurate if the oscillograms are taken in circular coordinates. A single cycle is several times as long when taken on circular oscillograms as when on rectangular, and this extension of the time scale and the geometric form of the curve allow more accurate subdivisions and more simple and accurate calculations of phase angles, harmonic analyses, root-mean-square values, power in watts, power factors.

The circular oscillograms obtained by the use of this attachment are in the correct form for use on the harmonic analyzer described on the following

page not requiring plotting from rectangular coordinate to circular.

### Operation

The oscillograph is adjusted as when taking oscillograms in rectangular coordinates, and the pictures are taken by exposing the circular film running at synchronous speed in front of the slot of the oscillograph. Each film holder is equipped with a small two-pole self-starting synchronous motor for driving the film in synchronism with the circuit being tested.

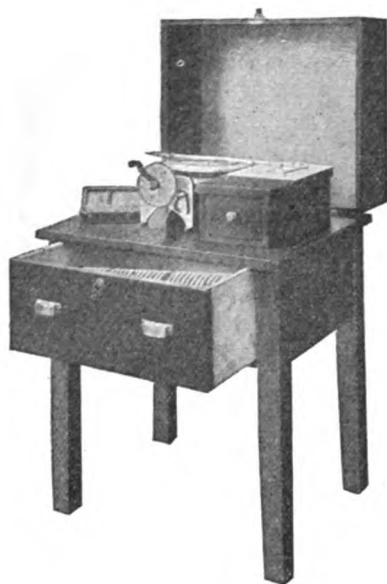
Driving the film at synchronous speed enables the cycle to be traced repeatedly, often allowing the use of a concentrated filament incandescent lamp instead of the troublesome arc lamp. It also enables several exposures to be made on the same film, in proper phase relation, to the same or different scale, and referred to the same or different zero circles; and therefore complete tests of any complicated single-phase or polyphase conditions can be made on a single film with a single oscillograph element and without the least confusion of the several periodic curves.

Description	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
Circular-Oscillogram Attachment Complete with Synchronous Motor	17	25	219159	\$70 00
One dozen sensitized films, 10 inches diameter, 3/8-inch hole	1 1/2	2	239784	13 00
One dozen sensitized template boards,* 10 inches by 10 inches	3	3 1/2	240171	5 00

\*Consists of sheet of sensitized paper stapled to a sheet of bristol board ready for printing and cutting out the template.

Order by Style Number

## HARMONIC ANALYZERS



### Application

By the use of this wave-form analyzer any periodic function can be investigated mechanically and resolved into its harmonic components so that its equation can be immediately written out: The variations of force, displacement, velocity, or acceleration can be analyzed and, since they are all related, the physicist or engineer can derive any or all of the others by differentiation or integration of the very simple sine or cosine terms of the equation of one of them. Waves of sound, temperature, magnetic flux, pressure, flow, torque, etc., can be easily investigated and their equations used to obtain functions of other related or dependent physical quantities.

By simple changes in adjustment, the apparatus can also be used to draw the harmonic components in their proper phase positions and to their proper amplitudes.

**Uses in Electrical Measurements**—The harmonic equation of electrical wave forms offers the most convenient means of expression, and allows quick and accurate calculations of engineering problems in which are involved questions of the paralleling of generators, possible cross currents and circulating currents in rotary converters, transformer connections, transmission line regulation, telephone troubles, and so forth.

This harmonic analyzer is the only instrument that can be used to obtain both a quick and accurate analysis of a voltage or current wave direct from the oscillogram. Analyses that were formerly long and tedious calculations which required a day's time and even then were only approximations,

can by this apparatus be obtained accurately in an hour.

### Operation

This apparatus extracts the components of the equation of the periodic function, one at a time and in any order desired. Without any knowledge of the principles of the apparatus, an accurate and complete analysis can be made in a few minutes by following a few simple directions which accompany the analyzer. More complete information on the operation and construction of the harmonic analyzer is given in Westinghouse Leaflet 3975.

**Circular-Oscillograph Record**—Analyses are made by the analyzer from curves in circular (polar) coordinates. These curves can be obtained directly from the circuit under test by the use of the Westinghouse "Circular-Oscillogram Attachment" (see following page) used with a standard oscillograph, or by plotting from the oscillograph record obtained in rectangular coordinates by the standard oscillograph a curve in circular coordinates. From the curves in circular coordinates, templates in bristol board are cut; these are used directly on the analyzer. The film record obtained by the circular oscillogram attachment is transferred by photographic printing to a sheet of sensitized paper; this is attached firmly to the bristol board and cut into the template.

Description	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
Harmonic Analyzer*	250	300	219087	\$650 00
Polar Planimeter	2	3	219088	30 00

\*Style number and list price of harmonic analyzer do not include polar planimeter which must be ordered separately.

Order by Style Number

3-369A

## HIGH-VOLTAGE MEASURING DEVICES

In high-voltage testing, a voltmeter connected to the primary of the testing transformer and calibrated in terms of the testing voltage, is satisfactory where accuracy is not essential or where the kilovolt-ampere capacity of the load is negligible. These conditions, however, are rarely ever fulfilled in service when making high-voltage tests and more

accurate methods are necessary. The Westinghouse Company offers two devices of the latter class, the spherical-spark-gap voltmeter and the crest voltmeter, both recommended by the A. I. E. E. (For insulation-testing transformers and equipments see catalogue section on "Transformer Apparatus and Testing Equipment.")

### ELECTROSTATIC VOLTMETER

This is an instrument of exceptional merit, possessing the requisite insulation for high voltages and being entirely free from the influence of external static fields. The energy required to operate it is negligible. The current-carrying parts are immersed in oil, which allows the instrument to be compact and also acts as a damper, producing dead beat readings; while the form of terminal used also adds to the compactness and insulating properties.

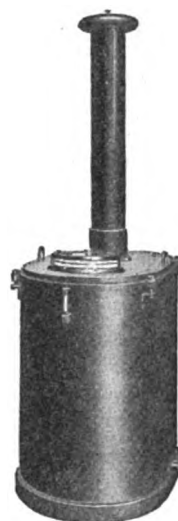
The instrument measures root-mean-square voltages.

**Operation**—When the core of the condenser terminal is connected to one side of the high-tension circuit and the tank is connected to the other side, grounded, the total difference of potential is divided up among the various condensers in series, and charges of opposite polarity, proportional to the voltage, are induced on adjacent faces. Each cylinder of the moving element is oppositely charged to the curved plate nearest to it, and an attraction exists between the charges on the cylinders and on the plates, which tends to cause rotation of the moving element. This rotation is opposed by a spiral spring, so that the deflection is a function of the charge and consequently of the voltage. The deflection is indicated by a pointer carried by the shaft and read on a horizontal edgewise scale. The scale is provided with a mirror to prevent parallax, and reads both in volts and in proportional divisions.

Provision is made for reading full scale at the voltages shown in the following table by short-circuiting layers of the condenser terminal, which gives a higher difference of potential across each of the remaining condensers. This is done without opening the case, by means of an insulated handle projecting through the cover.

**Construction**—The mechanism consists of a condenser terminal and a measuring condenser element mounted in a sheet iron tank with cast iron

cover. The terminal consists of concentric alternate insulating and conducting layers which form in effect a large number of condensers in series. The



ELECTROSTATIC VOLTMETER FOR 120,000 VOLTS

terminal is protected against the moisture of the atmosphere, particularly noticeable in hydro-electric power plants, by the water-proof insulating tubing sealed with moisture-resisting compound. The moving element, which is in series with several condensers at the grounded end of the series, consists of two hollow cylinders hung by a glass shaft from a bearing consisting of a specially hardened and highly polished steel ball between polished jewels. The cylinders move between two curved plates, one attached to a tank and the other to an outer layer of the terminal.

**Style number and list price** include voltmeter complete, ready for installation.

Style No	READABLE VOLTAGE LIMITS		List Price	Approx. Gals. Oil Required	APPROX. WT., LBS. WITHOUT OIL†	
	Maximum Range	Other Ranges*			Net	Boxed
54890	25,000 to 120,000	16,000 to 80,000 8,000 to 40,000 20,000 to 100,000	\$1000 00	50	415	720
54891	50,000 to 200,000	10,000 to 50,000	1200 00	130	525	900

\*Read on proportional scale by means of calibration curve.  
†Oil weighs approximately 7 1/2 pounds net per gallon.

**Note**—Special meters, without condensers, can be furnished for use with direct current. Capacities and prices may be had upon application.

*Order by Style Number*

## CYCLE COUNTERS

### FOR MEASURING TIME OF OPERATION OF RELAYS, CIRCUIT-BREAKERS AND MACHINERY

#### Application

The cycle counter is an instrument for indicating definitely the time of operation of any apparatus which is arranged to open or close at the beginning and end of its operation, an alternating-current circuit of known frequency. It is used especially where the interval of time is too short to be measured accurately by means of a stop watch and where the cost and complication of more delicate instruments, such as the chronograph and oscillograph, make these undesirable. While the cycle counter has an almost unlimited field of application, it is most commonly used to test the time elements of high-accuracy relays and circuit-breakers.

#### Operation

**Testing Relays**—When used to test relays, it is connected with the relay on a circuit adjusted to give the current value at which the relay is to operate. When the circuit is closed, the cycle pointer begins to revolve, one tooth of the escapement being released per cycle, continuing until the relay contacts are closed. The instrument starts the instant power is applied and stops the instant power is disconnected—it has no effective inertia.

**Testing Circuit-Breakers**—When used in testing the time of opening of circuit-breakers, the cycle counter is usually used in connection with an auxiliary relay (listed as an extra). This relay consists of two small relays, both of which have the same time lag. The energizing coils of these small relays are so connected to the pallet switch of the breaker that when the breaker trip coil is energized, one side of the auxiliary relay either opens or closes its contacts, according to its connection; and when the breaker is fully opened,

the other side opens or closes its contacts. These auxiliary-relay contacts are so connected to the cycle counter that when the breaker trip circuit is closed the cycle counter begins to operate and when the breaker is entirely open, the counter stops. Since both small relays operate in starting and stopping the counter, and each has the same time lag, no error is introduced.



#### Construction

The mechanism is virtually an electric self-winding clock with the escapement operated by an alternating-current oscillating magnet instead of a pendulum or balance wheel. At each cycle, one tooth of the escapement is released. The self-winding clock periodically rewinds from power supplied from a shunt connection to the circuit when the cycle pointer has made 60 revolutions (3600 cycles). The escapement magnet is not depended on to drive the indicator, but simply to regulate its speed.

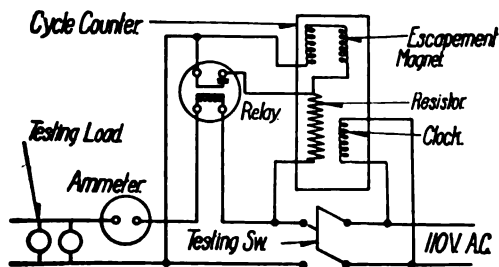


DIAGRAM OF CONNECTIONS

Volts	Frequency Cycles	APPROX. WT., LBS.		Style No.	List Price
		Net	Boxed		
100	Up to 60	<b>Cycle Counter</b>		237124	\$100 00
		8	20		
100	d-c.	<b>Auxiliary Relay</b>		252248	50 00
		1	3		

**Approximate Dimensions**—Overall width, 5¼ inches; overall height (handle lowered), 9¾ inches; overall depth, 4¼ inches.

*Order by Style Number*

## TYPES OF WESTINGHOUSE PROTECTIVE RELAYS

Type	Name	Rating and Circuit	Applications
A.....	Polarity Directional	{ 125, 250, 500, 750 volts d-c.	{ To disconnect a circuit upon reversal of polarity.
BT.....	Transfer	5 amperes a-c.	{ Used with other protective relays when it is desired to trip a breaker with energy from a current transformer.
CO.....	{ High Voltage— Overcurrent	4 to 12 amperes a-c.	{ On high voltage circuits which are not provided with current transformers.
CD.....	{ Selective— Differential	3 to 7 amperes a-c. ½ to 2 amperes a-c.	{ Parallel line protection.
CM.....	{ Phase Balance	2 to 6 amperes a-c. 2 or 3-phase	{ Protection against unbalance of the current in different phases.
CO.....	{ Time Limit Overcurrent	4 to 12 amperes a-c. 4 to 16 amperes	{ Protection against excessive current.
Low Energy } CO	{ Time Limit Overcurrent	4 to 12 amperes a-c.	{ Excess current protection where the current transformer can not carry much burden.
Low Energy } CO	{ Time Limit Overcurrent	½ to 2½ amperes a-c.	{ Differential protection of generators.
COA.....	{ Overcurrent with current indicator	4 to 12 amperes a-c. 1 and 3-phase	{ "Ground" relay for line sectionalizing.
CP.....	Reverse Phase	{ 110 to 220 volts 2 and 3-phase a-c.	{ Same as CO with the addition of an ammeter scale operating from the same electromagnet.
CR.....	{ Directional (Reverse Power)	4 to 12 A. } 110 volts a-c.	{ To protect against reverse phases and low voltage.
Low Energy CR	{ Directional (Reverse Power)	4 to 12 amperes 110 volts a-c.	{ To disconnect a short-circuited section of transmission system.
Low Energy CR	{ Directional (Reverse Power)	½ to 2½ amperes 110 volts a-c.	{ With bushing type current transformers.
CRA.....	{ Directional with current indicator	4 to 12 amperes a-c.	{ As a "ground" relay for line sectionalizing on systems where the ground current may be small.
CT.....	Temperature	{ 5 amperes (approximate), used in current transformer circuit	{ Same as CR with the addition of an ammeter scale operating from the same electromagnet.
CV.....	{ Over-voltage and Under-voltage	{ 110 to 220 volts a-c.	{ To protect apparatus from excessive temperature and overload occurring simultaneously.
CW.....	{ Power (Watt)	{ 50 to 300 watts 5 amperes 70 volts 100 to 600 watts 5 amperes 110 volts a-c.	{ To operate when the voltage changes above or below a known value.
CZ.....	Impedance	5 amperes 110 volts a-c.	{ As a control or alarm relay when the power flow varies from a predetermined amount or direction.
D.....	Reverse Current	{ 125, 250, 600, 1500 volts d. c.	{ Line sectionalizing.
D.....	Overload	{ 125, 250, 600, 1500 volts d. c.	{ To protect apparatus against a reversal of current.
DT.....	Temperature	{ 125, 250, 600, 1500 volts d. c.	{ Same as above, but adjusted to operate on higher current.
GK.....	Time Delay	125 volts d-c. or a-c.	{ Temperature protection or alarm. Uses d-c. control circuit and search coil in apparatus.
GR.....	Periodic Reclosing	125 volts a-c.	{ For securing long time intervals, adjustable up to 40 minutes.
HM.....	Bearing Thermostat	100 deg. cent.	{ For periodic service restoring.
HN.....	Grid Thermostat	150 deg. cent.	{ To guard against overheating of bearings—any machine.
M.....	Multi-contact	12, 125, 250 volts d-c.	{ Auxiliary. Intermittent duty. Controls 4 or 6 circuits.
MC.....	Multi-contact	{ 12, 125, 250 volts d-c. or a-c.	{ Auxiliary. Continuous duty. Various contact arrangements.
O.....	{ Auxiliary— Instantaneous and Time Limit	{ Various a-c. and d-c. circuits	{ Auxiliary.
R.....	{ Service— Restoring	110 volts a-c.	{ Restores service within less than 1 second from the time the interruption occurs.
S.....	{ Short Circuit Selecting	5 amperes d-c.	{ Used with current transformer on d-c. circuit to protect against short circuits—does not operate on overloads.
TO.....	{ Instantaneous Overload	40 to 80 millivolts d-c.	{ Apparatus and feeders.
TV.....	Voltage	{ 100 to 175 volts 200 to 350 volts d-c.	{ Instantaneous d-c. under- or over-voltage.
C.....	Annunciator	1 ampere d-c. or a-c.	{ Can be attached to any of the "C" line of relays to show when the relay operates.

## TYPES CO OVERCURRENT (OVERLOAD) AND CR DIRECTIONAL (REVERSE-POWER) RELAY

With Adjustable Definite Minimum Inverse-Time Limit  
FOR ALTERNATING-CURRENT CIRCUITS



TYPE CO OVERCURRENT RELAY

The types CO and CR relays are described first because they are representative of the entire Westinghouse line of type C relays (induction type) and because they are the most widely used protective relays. They are patterned after the Westinghouse type OA watt-hour meter and make use of many watt-hour meter parts.

These relays are useful in protecting apparatus, but they are noted principally for their excellent service in automatically sectionalizing transmission lines and distribution networks. They are made in two types, one the standard form and the other a special low-energy type which places a very small burden on the current transformers, which small burden is a necessary requirement under some conditions.

### DISTINCTIVE FEATURES

1. Can be quickly set for desired value.  
Setting is accomplished by means of adjustments on face of the relay. The setting is positive. No stop-watch, ammeter, rheostat, or other apparatus is necessary.
2. Simple adjustment.  
Inexperienced operators can adjust them. If emergency requires change in the setting, the load dispatcher can have the changes made instantly by telephoning to the operators on duty at the various points—no need to send an experienced relay man around.
3. Large range of adjustment.  
These relays can be set to operate on minimum currents of  $\frac{1}{2}$  to  $2\frac{1}{2}$ , 4 to 12, or 4 to 16 amperes, according to style of relay. The definite-minimum time of closing under short-circuit conditions can be adjusted from instantaneous to 2 seconds. Special relays can be furnished to give up to 4 seconds, although the 2-second relays allow of more accurate setting.
4. Have time-selective inverse-time element and definite-minimum-time functions.  
The time-selective function enables the relays controlling circuits in series to be set that they will each operate at different times. The inverse-time-element enables the relay to operate more quickly on large currents than on small ones. And combined with these functions, is a definite-minimum tripping time below which the relays cannot trip on any current. (See curves on faceplates of relays.)
5. Can be set to operate as a definite-time device instead of inverse-time.
6. Individually tested and the calibration curve hand-drawn on the name plate.  
This makes it possible for the engineer or operator in charge to make sure that all the settings are as they should be. The settings can be checked in a minute's time—no testing required for checking.
7. Have watt-hour-meter accuracy and permanence of calibration.  
Their accuracy is permanent and so reliable that relays controlling circuits in series can be set as close as  $\frac{1}{2}$  second apart, and still act selectively, even on extremely high currents. With some circuit-breakers, settings as low as  $\frac{1}{4}$  second have given perfect results.
8. Proper combinations of types CO and CR relay on a circuit will give selection in tripping of circuit-breakers never before obtained.
9. Will not trip due to synchronizing and line switching.  
The definite-minimum time-element allows time for surges to subside.
10. Have rugged construction.  
Types CO and CR will not be injured by the momentary passage of current as high as 200 amperes through them.
11. Will not over-swing and make contact if trouble is quickly cleared.  
Should the excess current in any relay be reduced to normal value as late as only  $\frac{1}{8}$  second short of the time for which the relay is set to operate, the movement will return to its normal position without closing the contacts.
12. High resetting value.  
Should the value of the current in the relay drop until it is but slightly below the minimum value required to trip, the relay will reset to its neutral position.
13. Require small amount of power to operate.  
The burden which these relays place on the current or voltage transformers is so small that the accuracy of meters installed on the same circuit is not affected.
14. Operate properly on low power factor.  
When used on three-phase systems, these relays will function correctly, no matter how low the power factor or abnormal the phase relations during the short circuit may be.
15. Operate on low voltage.  
The type CR will select as to direction of power even should the voltage drop to one or two per cent of normal.
16. The type CR relay will not trip a circuit-breaker under normal load conditions.

## TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued

## TYPE CO OVERLOAD RELAYS

## Application

The standard form of type CO relay is intended for the following applications:

- 1—Overload protection of motors, transformers, etc.
- 2—Differential protection of transformers.
- 3—Automatic sectionalizing of transmission systems.

(It is not generally recommended for the protection of generators; use the low energy type for that purpose.)

- 4—Special relays can be furnished for use with the "pilot wire" system of feeder protection.

**Method of Tripping Breakers**—The usual method of tripping circuit-breakers is by a direct-current shunt tripping coil. Type CO relays are particularly adapted for this service. Some circuit-breakers are arranged with the tripping coil connected in the secondary of the current transformer (transformer trip) which also supplies the relay. Type CO relays can be used to trip any circuit-breakers of the latter type if a type BT transfer relay (described on another page of this catalogue) is interposed between each type CO relay and the trip coil. On most styles of Westinghouse circuit-breakers a "direct-trip attachment" can be supplied. This attachment will allow the type CO relays to operate circuit-breakers by means of the transformer-trip coil; it is described in the catalogue on "Oil-Break Switching Equipment."

**Shunt Trip Circuit**—Standard type CO relays are equipped with single-pole contacts and will control only one trip circuit. Where two trip circuits are to be controlled by one relay, special type CO relays with double contacts and one extra terminal can be supplied. This extra contact can also be used to operate a bell alarm.

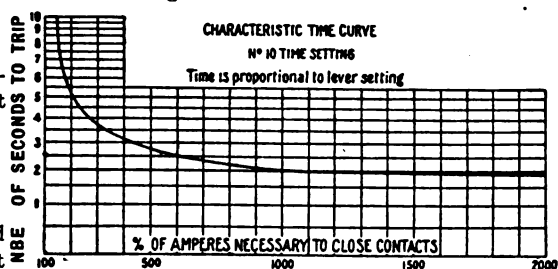
Where a circuit-breaker trip coil requires more than 30 amperes to operate it, a control relay should be used. For control relays and information as to current required by Westinghouse circuit-breaker trip coils, see sections on "Switchboard Accessories" and "Oil Circuit-Breakers."

## Operation and Construction

**Operating Principle**—The type CO overload relay consists of an induction type of instrument having the functions of an ammeter which closes its contacts on excess current. Damping magnets applied to the disk of the movement make the speed of rotation proportional to the driving force, as in a watt-hour meter; while the time element is adjusted by varying the distance through which the moving contact on the disk shaft must travel before it engages with the stationary contact on the adjusting arm.

**Definite-Minimum Time**—If the torque of a relay is allowed to increase with the current, the time element at high currents would be practically

instantaneous, thus preventing predetermination of order of relay action when several breakers are in series. In order to obtain definite-minimum time of closing at heavy currents a "torque compensator" is introduced in the instrument. This is a small transformer connected in the relay windings, and is so designed that at a certain value of current



the core becomes saturated so that the current in part of the relay windings, and consequently the relay torque, does not increase beyond this point. Standard type CO relays have a definite-minimum-time setting of two seconds. Four-second relays can be furnished, although their use, generally, is unnecessary and undesirable.

**Current Adjustment**—The tripping current is varied by changing the position of the screw in the terminal block in the top of the relay. Three different current ranges can be supplied, as follows:

- .5—7—9—1.2—1.5 (Not recommended for any particular purpose.)  
 4—5—6—7—8—10—12 Standard  
 4—6—8—10—12—14—16 Special

## Details and Accessories

**Internal Contactor Switch**—In order to relieve the relay contacts from the duty of carrying heavy tripping currents, all type CO relays are equipped with an internal contactor switch capable of closing a 30-ampere circuit at 220 volts.

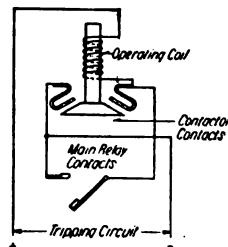


DIAGRAM OF CONNECTIONS OF CONTACTOR SWITCH WITH TYPE CO RELAY

The operating coil of this contactor switch is connected in series with the tripping circuit and its contacts shunt the main relay contacts (see diagram). Thus, when the main relay contacts are closed, the tripping circuit energizes the contactor switch operating coil as well as the circuit-breaker trip coil, but the action of the contactor switch is so nearly instantaneous that its contacts are closed before the direct-current tripping circuit has built

TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued

up to more than a moderate value. Thus, the contacts of the contactor switch relieve the main relay contacts from carrying any heavy current. The contactor-switch coil when energized also acts as a holding coil to keep its contacts closed even though the relay contacts have opened, until the tripping circuit be broken by pallet switch on circuit-breaker.

The standard contactor switch operates on a minimum trip current of 2 amperes. For values

below this, the switch will remain inoperative as the main relay contacts are capable of handling this current without difficulty.

**Auxiliary Contacts on Circuit-Breakers**—Where a relay is used, the circuit-breaker should always have auxiliary contacts (pallet switch) to open the trip circuit, relieving the relay contacts of this duty.

Type CO Overload Relays

Style number and list price include type CO relay complete with contactor switch but without current transformers. For number of relays required for each circuit, see diagrams of connections below.

Range of Current Settings (Min. Amperes to operate)	Frequency Cycles	2-SECOND MAGNETS		4-SECOND MAGNETS	
		Style No.	List Price	Style No.	List Price
<b>Single Trip Circuit</b>					
1/2 to 1 1/2	25	338232	\$36 00	.....	.....
1/2 to 1 1/2	50	333528	38 00	.....	.....
1/2 to 1 1/2	60	338233	38 00	.....	.....
4 to 12	25	*214238	38 00	328834	\$40 00
4 to 12	50	*323527	38 00	328835	40 00
4 to 12	60	*214237	38 00	328836	40 00
4 to 16	25	338234	38 00	328837	40 00
4 to 16	50	333528	38 00	328838	40 00
4 to 16	60	338235	38 00	328839	10 00
<b>Double Trip Circuit</b>					
1/2 to 1 1/2	25	319158	\$38 00	.....	.....
1/2 to 1 1/2	50	323529	38 00	.....	.....
1/2 to 1 1/2	60	319159	38 00	.....	.....
4 to 12	25	*319180	38 00	328840	\$42 00
4 to 12	50	*323530	38 00	328841	42 00
4 to 12	60	*319181	38 00	328842	42 00
4 to 16	25	319182	38 00	328843	42 00
4 to 16	50	323531	38 00	328844	42 00
4 to 16	60	319183	38 00	328845	42 00

Approximate Dimensions—Overall diameter 6 3/4 inches; depth from switchboard 6 1/4 inches; terminal mounting studs are suitable for panels up to 2 inches thick. \*Recommended range.

**Extra Contactor Switches**—Extra contactor switches Style No. 285398 can be supplied at a list price of \$3.50.

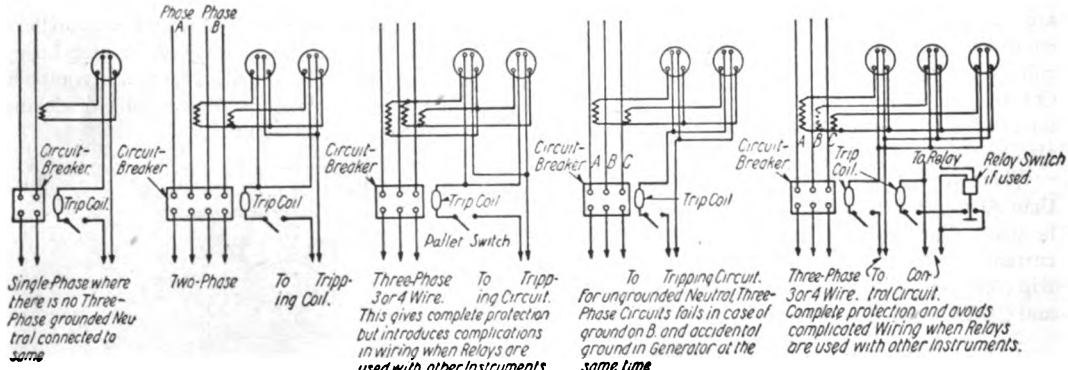


DIAGRAM OF CONNECTIONS, TYPE CO RELAY

LOW-ENERGY TYPE CO RELAY

Application

This relay is listed separately because its applications are somewhat different from the standard type. It is made in two ranges of current adjustment each of which has its own use. These uses are as follows:

(1) The 4 to 12-ampere range is to be used where low ratio bushing type current transformers are the only convenient means for supplying the energy to the relay. The burden placed upon the transformer

by this type of relay is less than 2-volt amperes at the tripping point. This relay should be used for line sectionalizing and the overload protection of power transformers where the low-energy type is necessary, but should not be used for the differential protection of power transformers because it is too sensitive.

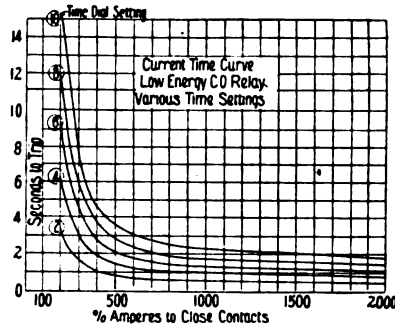
(2) The 1/2 to 2 1/2-ampere range is to be used for the differential protection of generators, large motors, etc., where a sensitive relay is desirable and



TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued

where the current transformers on both sides of the main winding can be exact duplicates.

(3) The 1/2 to 2 1/2-ampere relay is suitable also for use as a "ground" relay for the automatic sectionalizing of a system having its neutral grounded through a resistance which limits the ground current to a low value.



Operation and Construction

The construction resembles that of the standard type CO relay, but the torque compensator has been omitted and the definite minimum time characteristic obtained by gearing the disc to the contacts and running the disc at its "synchronous speed" at high overloads. As a result the curve is not quite the same shape as that of the standard CO but is a little more inverse. In all other respects the operation of the low-energy relay is the same as that of the standard and its general appearance and dimensions are the same so that the two types are interchangeable on the switchboard.

The relay is equipped with an internal contactor switch like the standard and is supplied with either single or double tripping contacts and a 2- or 4-second minimum time characteristic.

The contacts will close a circuit of 30 amperes, but a pallet switch which will open this circuit should be installed on the circuit breaker in accordance with the usual practice.

Range of Current Settings (Min. Amperes to operate)	Frequency Cycles	2-SECOND DEFINITE TIME Style No.	List Price	4-SECOND DEFINITE TIME Style No.	List Price
<b>Single Trip Circuit</b>					
1/2 to 2 1/2	25	*311782	\$45 00	328850	\$49 00
1/2 to 2 1/2	50	*328846	45 00	328851	49 00
1/2 to 2 1/2	60	*311783	45 00	328852	49 00
4 to 12	25	*328847	45 00	328853	49 00
4 to 12	50	*328848	45 00	328854	49 00
4 to 12	60	*328849	45 00	328855	49 00
<b>Double Trip Circuit</b>					
1/2 to 2 1/2	25	*328856	47 00	328862	\$51 00
1/2 to 2 1/2	50	*328857	47 00	328863	51 00
1/2 to 2 1/2	60	*328858	47 00	328864	51 00
4 to 12	25	*328859	47 00	328865	51 00
4 to 12	50	*328860	47 00	328866	51 00
4 to 12	60	*328861	47 00	328867	51 00

Approximate Dimensions:—Overall diameter 6 1/4 inches; depth from switchboard 6 1/4 inches; terminal mounting studs are suitable for panels up to 2 inches thick.

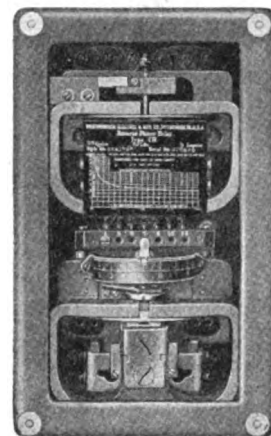
\*Recommended range.  
Weights—Net, 10 pounds. Boxed, 19 pounds.

TYPE CR DIRECTIONAL RELAY

Application

The standard form of type CR relay is recommended solely for use in the automatic sectionalizing of transmission lines. It has, in a few cases, been used for the protection of generators, but for this purpose, we recommend differentially connected low-energy type CO relay.

There are two classes of directional relays: the ordinary or uni-directional and the duo-directional. The uni-directional relays are intended to be installed on each separate feeder, whereas the duo-directional relay is to be connected between a pair of incoming lines at the substation end. The current transformers on the two lines are cross connected, so that the relay will trip whichever line is carrying the greater current away from the bus bars. The advantage of this arrangement over the use of the uni-directional relays is that one set of duo-directional relays costs less than two sets of the ordinary type. However, part of this advantage is lost because of the extra trouble and expense of making the cross connection. The duo-directional relay has been used on tie lines between generating stations



where the balanced feature was important, but the type CD selective differential relay is more suitable for this purpose.

It should be kept in mind that the type CR relay is intended only for use in sectionalizing defective

TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued

transmission lines. For regulating load or controlling the flow of power under normal conditions, the type CW relay should be used.

**Operation and Construction**

The type CR relay is a combination of two elements in one case; a type CO overload relay element, with its contacts in series with those of a selective wattmeter, or directional element. The overload element closes its contacts on excess current in either direction, but the contacts of the selective wattmeter element remain open as long as power flows into the station.

Each relay has three entirely separate adjustments: (1) the current at which it will operate, (2) the time in which it will operate, and (3) the direction in which the power must flow to operate it. It should always be connected to the circuit in such a way that it will trip its circuit-breaker when power is flowing away from the bus-bars. The term "Reverse-Power Relay" is somewhat misleading while "directional relay" is nearer correct and preferred.

Another way of explaining the operation of the type CR relay is by stating that it is in all respects similar to the type CO relay with its separate current and time adjustments, but is equipped with a check valve which will not allow it to operate when the power is flowing toward the bus bars.

**Adjustments**—The type CR relay like the type CO is made with either 2 or 4-second definite time adjustment and has current adjustments of 4-5-6-7-8-10-12 amperes or 4-6-8-10-12-14-16 amperes.

**Tripping Circuits**—Also like the type CO relay, the type CR relay is built in two types, one with a single tripping circuit and the other with a double set of contacts so that two circuit-breakers can be tripped simultaneously. Do not confuse the duo-directional relay, which will trip either one of two circuit-breakers with the uni-directional relay which will trip two breakers, simultaneously. The latter arrangement is sometimes desired when the station is equipped with a double bus system and each feeder has two circuit-breakers; one to each bus.

In this or similar cases, it is desirable to trip whichever breaker happens to be closed.

**Details and Accessories**

**Contactors Switch**—A contactor switch like that described on the preceding pages on "Type CO Overload Relay" is included with the type CR to relieve its main contacts of the higher currents required on some breakers. Standard type CR relays will therefore close 30 amperes at 220 volts, but will not open the tripping circuit under any conditions—auxiliary contacts (pallet switch) must be used on the circuit-breaker to open the tripping circuit when the breaker opens.

**Necessity for Delta Voltage Connection**—Reverse power relays should be connected so that their potential coils are energized by the delta voltage of the system. Sometimes, especially on extra high voltage systems, it is necessary to obtain the potential for the relays from the low voltage side of the main step-down power transformers, and if these transformers are connected delta-star, it will be necessary to connect the relays with their potential coils in star, in order to have the proper phase relation. For this service, relays can be furnished with 60-volt potential coils.

**Style number and list price** include type CR relay complete with contactor switch, but without current or voltage transformers. For number of relays required for each circuit, see diagram of connections below.

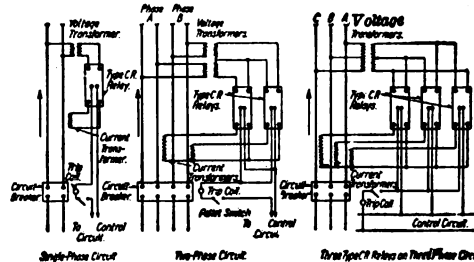


DIAGRAM OF CONNECTIONS, TYPE CR RELAY — REAR VIEW

NOTE: Relays operate when power flows in the direction of the arrow.

**Single Trip D-C. Contactor Switch for D-C. Tripping Circuits of up to 250 Volts**

Volts	Ampere Settings	Frequency Cycles	No. of Terminals	2-SECOND DEFINITE TIME		4-SECOND DEFINITE TIME	
				Style No.	List Price	Style No.	List Price
100	4 to 12	25	6	222173	\$85 00	328870	\$90 00
100	4 to 12	50	6	328862	85 00	328871	90 00
100	4 to 12	60	6	222174	85 00	328872	90 00
100	4 to 16	25	6	230270	85 00	328873	90 00
100	4 to 16	50	6	328869	85 00	328874	90 00
100	4 to 16	60	6	230271	85 00	328875	90 00

**Duo-Directional**

Volts	Ampere Settings	Frequency Cycles	No. of Terminals	2-SECOND DEFINITE TIME	
				Style No.	List Price
100	4 to 12	25	7	292985	\$100 00
100	4 to 12	50	7	328888	100 00
100	4 to 12	60	7	292986	100 00
100	4 to 16	25	7	292987	100 00
100	4 to 16	50	7	328889	100 00
100	4 to 16	60	7	292988	100 00

**Double Trip (Uni-Directional)**

2-SECOND DEFINITE TIME	Style No.	List Price	4-SECOND DEFINITE TIME	
			Style No.	List Price
328876	\$87 00	328882	\$92 00	
328877	87 00	328883	92 00	
328878	87 00	328884	92 00	
328879	87 00	328885	92 00	
328880	87 00	328886	92 00	
328881	87 00	328887	92 00	

Order by Style Number

TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued

LOW-ENERGY TYPE CR RELAY

Application

The low-energy type CR relay is made in two ranges, each intended for a different use as follows:

(1) The relay having a range of 4 to 12 amperes is intended for line sectionalizing to protect against short circuit in exactly the same way that the standard type CR relay is used, except that the low-energy type is necessary where the current transformers are of the bushing type, or of such other types that they can carry only a small secondary burden.

(2) The relay having a range of 1/2 to 2 1/2 amperes is intended for the automatic sectionalizing of transmission lines when used as a ground relay. The method of connecting this relay into the circuit is shown on the simplified diagram of the two parallel circuits which are connected with ground type CO relays at one end and ground type CR relays at the

other. It will be observed that only one ground relay is required per circuit and that short circuits are taken care of by the regular installation of line relays.

Operation and Construction

The overcurrent element of this relay is the same as the low-energy type CO relay and the entire relay is quite similar to the standard type CR and is interchangeable with it in every way. It is arranged to trip either one or two circuits simultaneously and can be provided with either 2 or 4-second definite time.

The directional element is the same as in the standard type CR relay, except that on the relays having the smaller current range, the current coil has more turns.

The relay is equipped with an internal contactor switch, the same as in the standard types.

D-C. Contactor Switch for D-C. Tripping Circuits of up to 250 Volts

Volts	Ampere Settings	Freq. Cycles	No. of Term.	SINGLE TRIP				DOUBLE TRIP					
				2-SECOND DEF. TIME Style No.	DEF. TIME List Price	4-SECOND DEF. TIME Style No.	DEF. TIME List Price	2-SECOND DEF. TIME Style No.	DEF. TIME List Price	4-SECOND DEF. TIME Style No.	DEF. TIME List Price		
100	1/2 to 2 1/2	25	6	358719	\$95 00	.....	.....	.....	.....	.....	.....	.....	.....
100	1/2 to 2 1/2	50	6	358720	95 00	.....	.....	.....	.....	.....	.....	.....	.....
100	1/2 to 2 1/2	60	6	358721	95 00	.....	.....	.....	.....	.....	.....	.....	.....
100	4 to 12	25	6	328890	95 00	328893	\$100 00	.....	.....	328896	97 00	328899	\$102 00
100	4 to 12	50	6	328891	95 00	328894	100 00	.....	.....	328897	97 00	328900	102 00
100	4 to 12	60	6	328892	95 00	328895	100 00	.....	.....	328898	97 00	328901	102 00

No. of Terminals

Weights—Net, 20 pounds. Boxed, 35 pounds.

TYPES COA OVERCURRENT AND CRA DIRECTIONAL RELAYS WITH SELF-CONTAINED AMMETERS

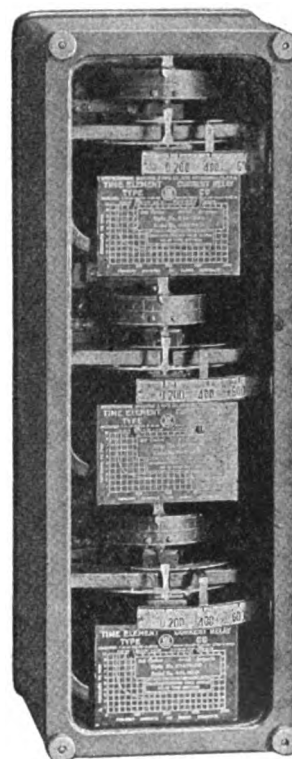
Application

As far as their protective features are concerned, these relays are exactly the same as the standard type CO and CR relays. However, in addition to the regular protective feature, they are equipped with a self-contained current-indicating element so that they give at all times an indication of the current flowing in the circuit to which the relay is connected. They are intended for use where the relays are mounted on the front of the switchboard and there is insufficient room to provide separate ammeters. Their use is also recommended where it is considered advisable to have supervision continually over the current circuit of the relay.

The type CRA relay is of course made in only the single-phase form, but the type COA is made both single-phase and 3-phase.

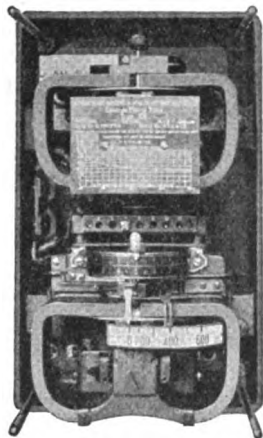
Operation

Each of these types of relay operates not only as a protective relay, but also, indicates the current which is flowing through the relay circuit, which not only indicates the current flowing in the feeder, or other circuit to which the relay is connected, but also proves to the operator that the relay is receiving current through its circuit and is therefore in condition to operate if a short circuit should occur. The current indicator is very rugged in its construction and cannot be injured by any short circuit to which the relay may be subjected.



TYPE COA "HELL-GATE" RELAY

TYPES CO OVERCURRENT AND CR DIRECTIONAL RELAYS—Continued



TYPE CRA RELAY

Construction

The indicating element consists of a thin copper disc mounted on a separate shaft and having its own jewel bearing and control spring, but actuated by the flux which also operates the main disc. Therefore, any accident which occurs either inside or outside of the relay to prevent the main electro-magnet from being energized will also keep the indicating disc from operating.

The indicating element instead of being equipped with a pointer as is the usual ammeter practice, is equipped with a moving scale and the pointer is stationary. The entire moving element is quite sturdy and well balanced and is fitted with a zero adjustment. Although the indicating disc occupies the same air gap that the main disc occupies under the electro-magnet, it does not use the same air gap in the permanent magnet. For damping purposes a small sector of aluminum is placed above the permanent magnet and a small soft iron magnet shunt robs enough flux from the permanent magnet to secure the necessary damping. This damping of the current-indicating element is sufficient only to make it nearly dead beat and does not slow up its operation to the extent that the operation of the main disc is affected.

Calibration

The indicating scale is fairly uniform and quite easily read. The control spring is of such a strength that full scale deflection is approximately 75% of the tap setting of the relay. It is possible to give this relay a universal calibration by marking it in per cent of the tap setting, but this is somewhat inconvenient, because in order to determine the current in the line, it will be necessary to read the indication of the relay and then calculate the primary amperes, taking into account the tap setting of the relay and the ratio of the current transformer. To eliminate this inconvenience we are prepared to calibrate every indicating scale in amperes provided we are furnished with the necessary information to do this. Suppose, for instance, the relay is to be used with a 300-ampere current transformer and is to be set to operate on the 7-ampere tap. Then the equivalent primary current of the relay setting is 420 amperes and 75% of that or the full scale of the indicating element is 315 amperes. We would therefore calibrate this relay and mark it zero 100-200-300. The scale is marked on a plain piece of white bristol board which can be very easily changed by the user so that if the relay tap setting should be changed it will be easy to recalibrate the relay and mark a new scale.

Details

Except for the indicating element, the type COA and CRA relays are similar to the standard type CO and CR in application and dimension, capacity, contact, etc., except that they are made only in the 2-second range and are made to trip only one circuit.

Style number and list price include complete calibrated relay. Order by style number and give calibration desired on the ampere scale, whether in per cent or amperes. If the latter, give the current transformer rating and the tap setting at which the relay will be operated. Unless otherwise ordered, the current indicating scale will not necessarily have a range of 75% of the tap setting, but the nearest percentage will be used that will give an easily readable combination.

Type COA

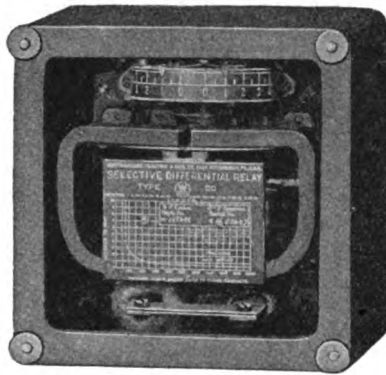
Circuit	Frequency in Cycles	Style No. Single-Phase	List Price	Style No. Three-Phase	List Price
125 volts, 4-12 amperes	25	374921	\$60 00	374924	\$175 00
125 volts, 4-12 amperes	50	374922	60 00	374925	175 00
125 volts, 4-12 amperes	60	374923	60 00	374926	175 00

Type CRA

125 volts, 4-12 amperes	25	374927	110 00	.....	.....
125 volts, 4-12 amperes	50	374928	110 00	.....	.....
125 volts, 4-12 amperes	60	374929	110 00	.....	.....

Order by Style Number

## TYPE CD SELECTIVE-DIFFERENTIAL CURRENT RELAY



TYPE CD RELAY

### Application

This relay is designed primarily for the short-circuit and ground protection of parallel transmission lines. It is not directional, but uses the scheme of balanced protection, selecting the line carrying the heavier load. It may be applied to any number of parallel lines, care being taken that it is applied to the system so that when a fault occurs, the defective line will be certain to carry the heavier current. Thus it may be applied at the generating end of any number of parallel feeders, but at the substation end at least three lines are required to secure unbalanced current in the faulty line. Thus ideal applications for this relay are for the protection of parallel tie lines between generating stations and for the protection of parallel lines in a loop or interconnected system when power feed will always be available at both ends of the lines.

### Operation and Construction

The type CD relay works on the induction principle and operates on current alone. In effect, it has two overload elements acting upon a common

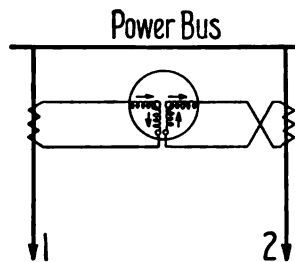


FIG. 1—SELECTIVE DIFFERENTIAL RELAYS APPLIED TO TWO PARALLEL FEEDERS.

disc through a common magnetic circuit. Each element is connected separately to its own current transformer in corresponding phases of the two

balanced lines. The two elements are electrically opposed and under a condition of balanced line loads the fluxes in the magnetic circuit of the relay are equal and opposite giving a resultant zero torque on the relay disc. Under these conditions the disc which carries the moving contact is held in a middle position by the control springs. These springs are initially restrained in the zero position which prevents the disc from making any movement until a predetermined current unbalance exists between the two lines. Under the proper conditions of current unbalance the disc can rotate  $80^\circ$  in either direction from zero and make contact on either side. Thus the moving contact acts as a single-pole double-throw switch in the trip circuits of the circuit-breakers of the two balanced lines, and will trip out the circuit-breaker on the line carrying the heavier load. This action is the same regardless of the relative directions of the currents in the two lines. The schematic diagrams of the connections are shown in the figures below, illustrating the methods of applying this relay to the protection of transmission lines. (Refer Figs. 1 and 2.)

The differential current which is required to trip the relay is practically the same for all values of line current in the lower loaded line. If, however, one line of the balanced pair is open, the current in the relay necessary to cause it to trip-out the remaining line is, approximately, twice the differential current setting. This automatic doubling of the current setting with one line open is due to

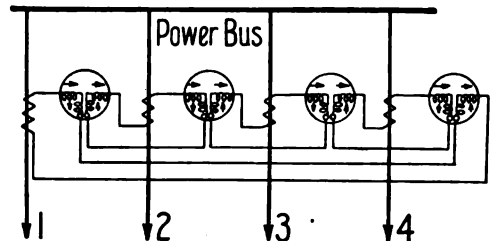


FIG. 2 — SELECTIVE DIFFERENTIAL RELAYS APPLIED TO FOUR PARALLEL FEEDERS. ONLY ONE PHASE IS SHOWN. THE ARROWS INDICATE INSTANTANEOUS DIRECTIONS OF THE CURRENT.

the fact that half of the operating coil of the relay is then no longer active, as it receives no current from the dead current transformer in the open line. This is a very desirable feature as it gives automatic protection to the service if one line is accidentally opened. Also, it may be used to provide overload protection for the last line if the short time setting of this relay does not interfere with other relay settings on the system. Overload relays in series with the differential relay are usually recommended, however, for this purpose.

The type CD relay can also be used for the ground protection of parallel transmission lines. The

TYPE CD SELECTIVE-DIFFERENTIAL CURRENT RELAY—Continued

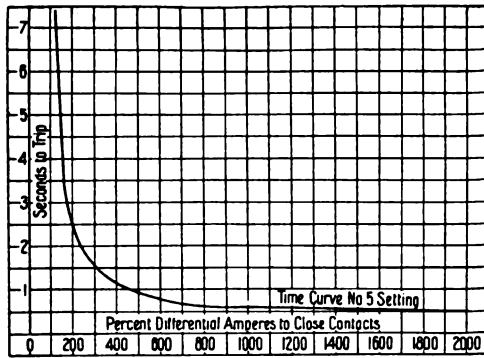


FIG. 3.—TYPICAL LOAD-TIME CURVE OF CD SELECTIVE DIFFERENTIAL RELAY.

neutral currents of the two lines are then balanced against each other and in case of a ground on one line the predominance of current will be in the neutral of the grounded line. The ground relays are identical with the line relays except that they operate on lower differential current values.

Distinctive Features

- (1) It operates on current alone, and no source of potential is required. This is a decided advantage, particularly, on high voltage lines where the cost of potential transformers is considerable.
- (2) The differential current setting is automatically doubled when one line is opened at one end. This enables the use of a minimum differential current setting, and it eliminates the necessity of additional apparatus in the trip circuit to render it non-automatic until both lines are in service.
- (3) Each current transformer may be grounded, thus giving maximum protection to the apparatus. This is not ordinarily possible with balanced protection.
- (4) A minimum number of relays is required, as each relay is double acting.

(5) Instantaneous disconnection of the defective line is possible.

(6) The same relay provides both differential and overload protection if desired.

Details and Accessories

**Internal Contactor Switches**—This relay is provided with two 3-point internal contactor switches to relieve the main double-throw contacts of the duty of carrying heavy tripping current. These switches will operate on two amperes d-c. and will close 30 amperes at 220 volts on the contacts. The three points of the two switches are brought out to a common terminal which is ordinarily used as a bell alarm connection.

Differential current settings of 3, 4, 5 and 7 amperes are provided on the line relays and 0.5, 0.6, 1.0 and 2.0 amperes on the ground relays. The relay has an inverse-time curve, with a definite minimum time of operation, adjustable from instantaneous to 0.5 second, as shown in Fig. 3.

**Extra Current Screws**—An extra current screw is provided in each of the two coil terminal plates of this relay. It is normally left in an idle hole marked "X." When it is desired to change taps it may be removed and screwed into the new current tap hole and the old screw then removed from the previous current tap and placed in the idle hole "X."

**Pallet Switches**—The tripping circuits of this relay must be opened by the pallet switch when the relay trips the breaker.

**Style number and list price** include type CD relay complete with contactor switches without current transformers. For the number of relays required for each circuit, see Figs. 4 and 5.

Ampere Range	Frequency Cycles	APPROX. Wt.		Style No.	List Price
		Net	Boxed		
3-7	25	20	20	333002	\$40 00
3-7	50	20	20	333001	40 00
3-7	60	20	20	333000	40 00
0.5-2.0	25	20	20	372578	40 00
0.5-2.0	50	20	20	372579	40 00
0.5-2.0	60	20	20	372580	40 00

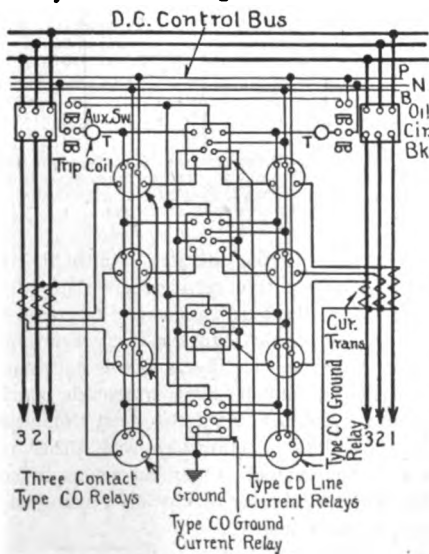


FIG. 4—PARALLEL LINE AND GROUND PROTECTION FOR TWO LINES USING TYPES CD AND CO RELAYS.

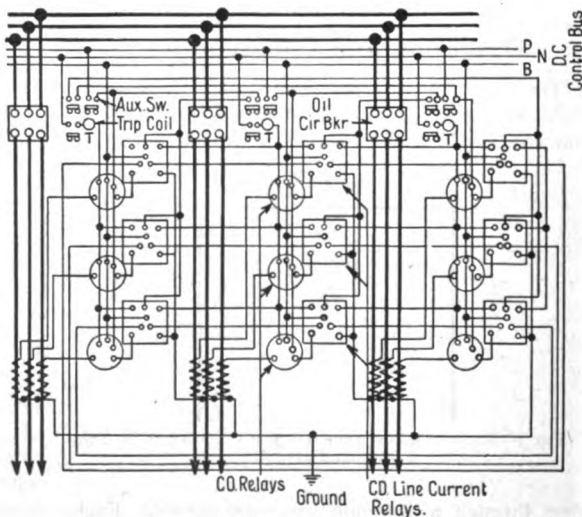
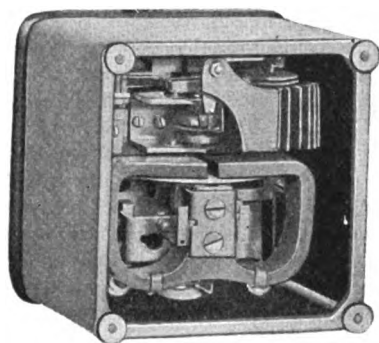


FIG. 5—COMPLETE CONNECTIONS FOR THE PROTECTION OF THREE OR MORE PARALLEL LINES. THE AUXILIARY SWITCHES ARE SHOWN FOR THE OPEN POSITION OF THE CIRCUIT-BREAKER.

## TYPE CZ IMPEDANCE (DISTANCE) RELAY FOR ALTERNATING-CURRENT CIRCUITS



TYPE CZ RELAY

### Application

This relay, which is based upon an entirely new principle, is intended only for the purpose of sectionalizing transmission lines upon the occurrence of short circuits. It is so designed that irrespective of the location of a short circuit, the nearest relay will operate the quickest and therefore clear the trouble in a very short period of time. The more complicated the network, the easier it is to apply this relay and it can therefore be used where the application of our types CO and CR relays is quite difficult or even impossible.

Although this relay can be applied to any system to protect it against short circuits, which includes grounds on a solidly grounded neutral system, it will not clear grounds on a system having the neutral grounded through a high resistance. For such a system the type CZ relay should be used to protect against short circuits and the low-energy type CR should be used as a ground relay.

### Distinctive Features

Long and tedious calculation, calculating tables and other devices are not necessary since the type CZ relay makes its own calculations and determines its own speed of operation whenever a short circuit occurs. Each feeder has its own set of relays and it is not necessary to balance the lines in pairs or use any particular line arrangement. If for any reason a short circuit on a feeder should fail to clear, the next set of relays in the series will operate to clear the trouble. Furthermore, if trouble should occur on any station bus bars, all the feeders supplying this station would be opened at the closest switching point, thus killing the station in trouble and effectively clearing the disturbance from the remainder of the system.

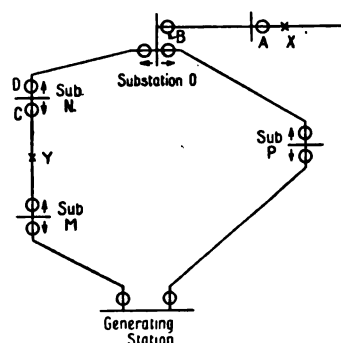
Even when trouble is close to the generating station, which with a typical installation of type

CO and type CR relays would require some time to clear, the type CZ relay will operate instantaneously. This principle of having the relay nearest the short circuit operate first is of particular benefit in decreasing the strain on the circuit breaker, since the final interruption of the short circuit is always accomplished with a considerable length of line between the generating station and the trouble.

### Operation

As usually applied this relay requires for its operation the use of current and potential transformers. The current element tries to close its contacts in a time varying inversely as the current whereas the voltage coils holds them open for a time varying directly as the voltage. Stated mathematically  $T = \frac{E}{I}$  but  $\frac{E}{I} = Z = \text{impedance} = \text{distance}$ . Stated in non-mathematical language, the time of operation of this relay varies as the distance of the short circuit from the relay. This applies not only to "dead" but also to "high resistance" short circuits, assuming that the latter is possible.

Referring to the diagram the conditions most difficult for proper discrimination in the time element are those encountered by relay A and B when a short circuit occurs at the point X. Since



APPLICATION OF TYPE CZ RELAYS TO TRANSMISSION OR DISTRIBUTION SYSTEM

both A and B have the same current flowing through them, the increased time element required by B can only be obtained by the increase in potential at B above that at A. The CZ relay is so designed that, if with the minimum possible short circuit which can flow to X, there is a difference of 5 per cent in the voltage between A and B proper discrimination will be obtained. For heavier short circuit where the drop in voltage will be more than

## TYPE CZ IMPEDANCE (DISTANCE) RELAY—Continued

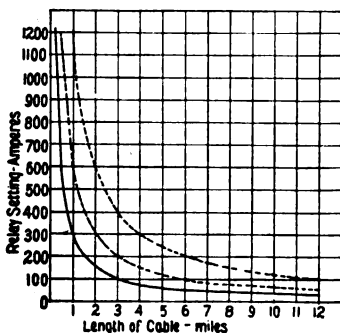
5 per cent the action of the relays can be made much quicker and more reliable. In other words, the only limitation on the application of the type CZ is that the switching stations must not be too close together.

Another condition which must be met is that which is due to a short circuit at Y in the diagram. Under such a condition the relay at C in substation N should of course operate, but the voltage and current condition will be exactly the same on both relays C and D. Therefore, in order to prevent the relay D from operating it is necessary to equip it with a device similar to a check valve which will prevent it from operating whenever power is flowing into the substation. This device is known as the directional element and consists of a contact-making wattmeter with its contact in series with the main contact of the relay. This principle is the same as that employed in our type CR relay which has been so successfully used for many years.

On the diagram the arrows shows where directional type CZ relays are required also indicating by the same symbol, the direction in which they will operate when trouble occurs. Of course the directional element will not be required at generating stations and some other points on the system. It is important to observe that the normal direction of power flow has nothing whatever to do with the operating of these relays.

## Construction

The watt-hour meter principle is also followed in this relay and many of its parts are common to watt-hour meters and to other protective relays. The aluminum disc which is operated by the current electromagnet, has its speed of operation determined by the setting of the permanent magnet. This disc is geared to a wheel which carries a floating spiral spring, one end of this spring being fixed to the gear and the other end to the contact to pull the contact closed, but the contacts are held open by a voltage coil. This voltage coil pulls on a small steel core so proportioned that it is saturated at a very low



CHARACTERISTIC CURVES OF TYPE CZ RELAYS WHEN USED ON 6600-VOLT, 60-CYCLE SYSTEM, USING #0000 CABLE. DASH LINES SHOW EFFECTS OF VARIOUS VOLTAGE ADJUSTMENTS

voltage and the pull upon it varies directly as the voltage. In order to eliminate the effect of residual magnetism, this core is made of a special steel developed by the Westinghouse Research Organization and which has practically no hysteresis loss or residual magnetism. A resistance is connected in series with the coil for the purpose of decreasing its temperature and frequency errors.

The directional element is required on practically all type CZ relays. It is located below the distance element and is quite similar to the directional element in our type CR relay. It is important that the type CZ relay be connected in the circuit so as to use the equivalent of the delta line voltage in the same way that the type CR relay uses it. For this reason, the relays are ordinarily wound to operate at a normal voltage of 110. In many cases where delta-star potential transformers are used or some other connection is made which shifts the phase relation by 30° it is convenient to connect the relays in star so that their potential coils will be affected by the equivalent of the delta line voltage. This can be most easily taken care of by the use of 70-volt relays which are to be connected in star on the normal 110-volt circuit.

**Adjustments**—Since it is always desirable to clear short circuits as quickly as possible, the type CZ relay is provided with adjustments so that no matter how long the section of line which is being protected it will be just as quickly disconnected as a short section in case of trouble. Two adjustments are provided, first the current adjustment which determines the minimum current value at which the relay will operate. The other adjustment is a resistance in series with the potential coil. By the use of these adjustments the relay can be set to operate on any length of line.

In setting this relay, it is necessary to consult the tables in the instruction book, considering the voltage and frequency of the system and the length and size of the section of line to which the relay is to be applied.

The maximum time required for the relay to clear any short circuit is about  $\frac{3}{4}$  seconds so that if  $\frac{1}{4}$  seconds is allowed for the opening of the circuit breaker, all troubles should be cleared within one second. In a few favorable cases this time will be considerably decreased and in unfavorable cases this time may be increased by as much as  $\frac{1}{4}$  second. The accompanying figure shows the characteristic of the relay as applied to a particular system.

**Contacts**—The type CZ relay is arranged to trip only one circuit breaker. Where it is necessary to trip two or more circuit-breakers simultaneously it is usually necessary to provide an auxiliary relay to accomplish this purpose. A contactor switch is provided in the tripping circuit.

**Bell Alarm**—All relays are equipped with a third point on the contactor switch and an extra terminal in order that a bell alarm may be operated if desired whenever the relay trips the breaker. This contact



**TYPE CZ IMPEDANCE (DISTANCE) RELAY—Continued**

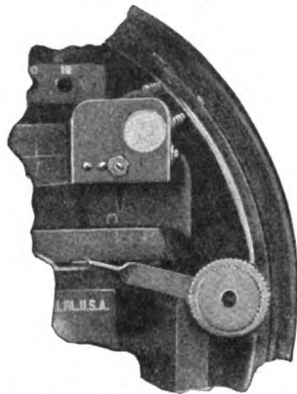
can of course be used for such other purposes as are desirable.

Auxiliary contact on the circuit-breaker, must be provided so that when the circuit-breaker is tripped,

Volts	Cycles	Style No. With Directional Element	List Price	Style No. Without Directional Element	List Price
125	25	374864	\$110 00	374870	\$80 00
125	50	374865	110 00	374871	80 00
125	60	374866	110 00	374872	80 00
70	25	374867	110 00	374873	80 00
70	50	374868	110 00	374874	80 00
70	60	374869	110 00	374875	80 00

Approximate Dimensions—With directional element height 10 $\frac{1}{4}$ -inch, width, 6 $\frac{3}{4}$ -inch, depth, with switchboard 6 $\frac{1}{4}$ -inch, net weight, 20 pounds, boxed weight, 35 pounds.  
Without directional element height and width 6 $\frac{3}{4}$  inches, depth from switchboard 6 $\frac{1}{4}$  inches, net weight, 10 pounds, boxed weight, 19 pounds.

**TYPE C ANNUNCIATOR (OPERATION INDICATOR) FOR USE WITH THE TYPE C LINE OF RELAYS**



SECTION OF A TYPE CO RELAY SHOWING ANNUNCIATOR MOUNTED, AND MECHANICAL RESET

**Application**

The purpose of this device is to give a visual indication that the induction relay to which it is attached has closed its contacts and that the trip circuit has been energized. It may be applied to any Westinghouse induction-type relay without any drilling being required on the relay.

**Operation and Construction**

The indicator consists of a solenoid, the coil of which is connected in series with the d-c. trip circuit. When the relay closes contacts, thus energizing the trip circuit, the circuit breaker trip coil and operation indicator are operated simultaneously. The armature of the indicator is deflected

the tripping circuit will be opened thus relieving the relay contact of that duty.

Style number and list price include relays complete, but without current or potential transformers.

into its tripped position and brings into view a white flag  $\frac{1}{2}$  inches in diameter which shows up permanently against the black background of the relay through the glass cover.

After the indicator has tripped it can be reset to its normal concealed position without removing the relay cover, by one of two methods.

(1) **Permanent magnet reset**—A permanent magnet can be supplied which when passed by the indicator outside of the glass cover will attract the iron vane flag to its initial position.

(2) **Mechanical reset**—A mechanical reset can be supplied, which may be permanently attached to each relay cover, and by means of which the indicator may be reset by hand. This device consists of a small brass tube which, on the round glass-covered relays, is slipped through the cover stud hole and carries on its inner end an armature and on its outer end a knurled washer. After loosening the cover thumb nut, the knurled washer may be turned, and the armature strikes the tail of the flag and resets the indicator. A spring returns the resetting armature to its initial position. No drilling is required to attach this device to the round glass covered relay, only a screw driver being necessary to tighten the set screw in the knurled washer. To apply this reset to the metal edge glass covered relays of the CR type, it is necessary to bore one  $\frac{3}{16}$ -inch hole in the metal edge of the cover to insert the brass tube.

**Operation Indicators**

Type of Relay	Operating Current A-C. or D-C.	Approx. Resistance Ohms	Side of Mounting	Style No.	List Price
Standard Type CO, CR, CD, CV, CW	1.0	0.06	Right	375367*	\$2 50
	0.1	6.00	Right	375370*	2 50
Old Type CR	1.0	0.06	Left	375365*	2 50
	0.1	6.00	Left	375369*	2 50
Low-Energy Types CO and CR	1.0	0.06	Right	375364*	2 50
	0.1	6.00	Right	375368*	2 50
Directional and Non-directional Types CZ	1.0	0.06	Left	375366*	2 50
	0.1	6.00	Left	375373*	2 50

**Mechanical Reset Devices**

For Standard and Low Energy Types CO, CV, CW..	....	....	Right	375371	\$0 50
For Standard and Low Energy Types CR and CD...	....	....	Right	375691	50
For Dir. and Non. Dir. Types CZ and Old Type CR.	....	....	Left	375372	50

**Permanent Magnet Reset**

Type of Relay	Description	Style No.	List Price
For all types	Permanent Mag. complete with keeper	356747	\$0 50

\*The 0.1-ampere indicator is intended for use with multi-contact relays, and the 1.0-ampere indicator for use with breaker trip coils requiring 2 or more amperes to operate.

Any of the Induction Type Relays listed in this Catalogue may be supplied equipped with the Operation Indicator (and mechanical reset also, if desired) by ordering the relay as follows:—

"Type..... Relay Style Number....., except to be equipped with Operation Indicator Style Number..... (and mechanical or magnetic reset Style Number.....)"

Add \$2.50 extra to list price of relay for the Indicator alone, and \$3.00 extra for Indicator plus mechanical or magnetic reset.

\*When ordering Operation Indicator specify type of relay to be used on.

## TYPE CB OVERCURRENT RELAYS FOR HIGH-VOLTAGE ALTERNATING-CURRENT CIRCUITS SHUNT-TRIPPING

### Application

In high-voltage stations requiring overcurrent protection, and where the extra cost of high-voltage current transformers has an important bearing on the selection of protective equipment, the type CB relay affords ample overcurrent protection at a minimum cost. It is particularly recommended for use on circuits of 100 amperes or less. For heavier currents the use of bushing-type current transformers operating type CO relays will be found more convenient and economical. Type CB relays are for indoor use, and are arranged for pipe mounting.

### Construction and Operation

The relay consists of a circuit-closing element operated by means of a standard current transformer, type CO relay and special type BT relay through a micarta chain of such length as to provide ample insulation for the voltage in use. The type CO relay, type BT relay and current transformers are mounted on one base which is in turn supported

from an insulator. The type CO relay is standard having a 4 to 12-ampere range, and a 2-second inverse definite minimum time limit. The operation of this relay serves to close the circuit of the releasing coil on the type BT relay.

The current transformer is a standard type KR, and can be supplied in various ratios according to the capacity of the system. The contacts of the type CB relay will control 3 amperes at 100 volts.

The circuit-breakers should be equipped with auxiliary contacts to open the trip circuit when the breaker opens, thus relieving the relay contacts of this duty.

Up to 35,000 volts, the type P bus support is used as an insulator for mounting the outfit. Above 35,000 volts, a pillar-type insulator is used.

Style number and list price include relay complete with transformer, micarta chain, and insulator. When ordering specify frequency at which relay is to be used, and ratio of current transformer.

Voltage	*Approx. Overall Length	APPROXIMATE WEIGHT, LBS.		Style No.	List Price
		Net	Boxed		
25000	8' 4"	55	100	268395	\$150 00
37500	8' 8"	60	110	268396	180 00
50000	13' 4"	150	250	268397	200 00
73000	19' 6"	225	300	268398	230 00
95000	19' 11"	325	400	268399	320 00
115000	24' 8"	375	450	268400	350 00
130000	25' 2"	450	525	268401	375 00

\*The overall length given above is for reference only. For official dimensions, refer to the nearest district office. Links may be removed to shorten the chain down to a minimum of 1 link for each 6600 volts.

## TYPE CT TEMPERATURE RELAYS FOR ALTERNATING-CURRENT CIRCUITS

### Application

The type CT relay may be used to protect any alternating-current apparatus from excessive heating if the apparatus is so arranged that exploring coils can be installed.

### Operation and Construction

The type CT temperature relay operates on the Wheatstone Bridge principle. Two arms of the bridge are copper exploring coils arranged to be placed in the oil or embedded in the windings of the apparatus to be protected, the other two arms are fixed resistances mounted in the relay. The current for the bridge is supplied by a current transformer connected in the circuit of the apparatus to be protected. The relay has two windings, corresponding to and co-operating to produce torque in a manner similar to the current and voltage coils of a wattmeter. The main winding is a coil operated directly by the current transformer. The auxiliary coils are connected to the Wheatstone Bridge arms similar to a galvanometer connection, and thus receive current the magnitude and direc-

tion of which depends upon the resistance of the search coils. Above a certain temperature the torque of the relay is in the contact direction; and below, in the opposite direction. It will thus be noted that, in order to close the contact, two predetermined conditions must co-exist: excess current, and excess temperature. Neither one will separately trip the relay.

The type CT relay is similar in construction to the type CO.

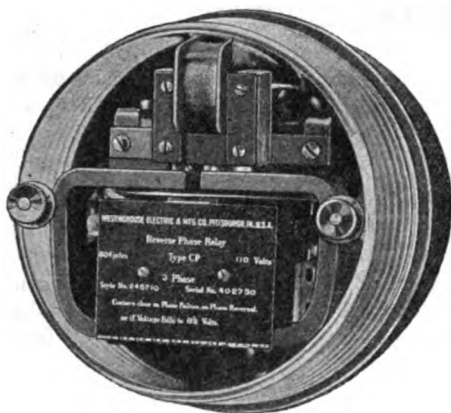
Style number and list price include relay complete as described except "exploring coils" which are usually furnished as part of the order for the apparatus to be protected.

In ordering, state resistance of exploring coil and temperature at which it is desired that the relay shall operate. One current transformer is required for each relay.

Frequency Cycles	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
25	10	20	249519	\$45 00
60	10	20	249520	45 00

Approximate Dimensions—Overall diameter, 6½ inches; depth from switchboard, 5¼ inches; terminal mounting studs are suitable for panels up to 2 inches thick.

## TYPE CP REVERSE-PHASE RELAYS



### Application

For use on polyphase circuits to provide protection against phase reversal.

It will also protect against an open phase, such as might be caused by a blown fuse, provided the motors on the circuit are so heavily loaded that they cannot maintain voltage on the open phase.

### Distinctive Features

The operating characteristics are exceptionally positive and reliable. If a phase is reversed, or if a phase fails, or if voltage drops below 75 per cent of normal, the contacts close and trip the circuit-breaker, either through a shunt trip coil or by short-circuiting an undervoltage trip coil having a series resistor.

It should be borne in mind that a relay of this type will not operate on open phase unless the voltage across the relay in the corresponding phase falls below normal or fails altogether. Thus, it can not be used for protection against open phase on an induction motor which runs continuously, or any class of apparatus which tends to hold up the voltage across an open phase, unless the apparatus is so heavily loaded that the voltage on the open phase will be lowered. It will, however, protect against phase reversal on any apparatus and affords good open-phase protection for induction motors which are started and stopped frequently, as in elevator service. As soon as the motor stops, the voltage across the open phase falls, and the relay operates, thus preventing the motor from being started until the defect is remedied.

### Operation

The relay operates on the induction principle. When properly connected to motor terminals, as shown in diagram of connections, the torque holds the relay contacts open against the restraint of a spiral spring. On failure of, or low voltage, the torque diminishes, and the spring closes the contacts. On reversal of phase connections the reversed torque assists the spring in closing the contacts.

### Construction

The type CP relay is of the same general construction as the type CO, the main difference being in the windings, which are made up of coils connected across the phases.

### Details and Accessories

**Voltage Transformers**—When used on voltage higher than 250, two voltage transformers are required with the 110-volt relay.

The contacts will close 5 amperes at 250 volts or less.

In some installations where the circuit-breaker or switch has a low-voltage-release coil it is convenient to place a resistance in series with the coil and arrange the relay to short circuit the coil when it operates thus tripping the breaker.

**Auxiliary Contacts on Circuit-Breakers**—When direct-current is used for tripping, the circuit-breaker should have auxiliary contacts to open the trip circuit, relieving relay contacts of this duty.

**Style number and list price** include relay complete. Transformers should be ordered separately. See pages on "Voltage Transformers."

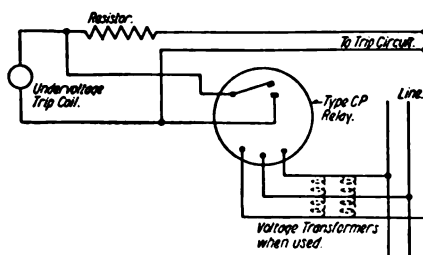


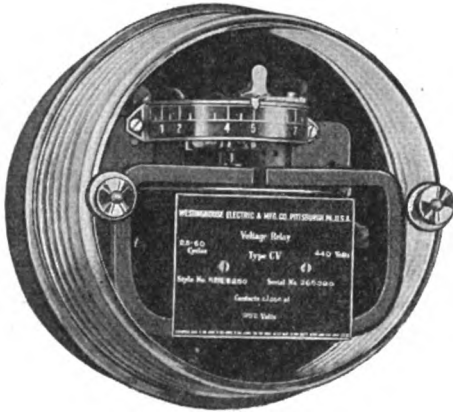
DIAGRAM OF CONNECTIONS, TYPE CP RELAY

Volts	APPROX. WT., LBS.		STYLE NUMBER						List Price
	Net	Boxed	TWO-PHASE, 4-WIRE		TWO-PHASE, 3-WIRE		THREE-PHASE, 3-WIRE		
			25 Cycles	60 Cycles	25 Cycles	60 Cycles	25 Cycles	60 Cycles	
110	11	20	245713	245714	245709	245710	333676	333677	\$45 00
220	11	20	245715	245716	245711	245712	333678	333679	45 00

**Approximate Dimensions**—Overall diameter, 6  $\frac{1}{2}$  inches; depth from switchboard 5  $\frac{1}{2}$  inches; terminal mounting studs are suitable for panels up to 2 inches thick.

Order by Style Number

## TYPE CV VOLTAGE RELAYS FOR ALTERNATING-CURRENT CIRCUITS



### Application

In some cases it is necessary to protect a circuit against abnormal increases or decreases in voltage. For this purpose the use of the type CV relay, which is arranged to close an auxiliary circuit that will trip a breaker, ring an alarm, or give some signal so that the operator will know that the circuit requires attention, is recommended.

Another use for this relay is as an auxiliary timing device for various automatic operations and factory processes.

### Operation and Construction

The type CV relay is similar in appearance to the type CO relay and the operation is similar except that it has the action of a voltmeter instead of an ammeter. The relay can be furnished so that it will close a circuit when the voltage rises above

its calibrated value or close a circuit when the voltage drops below the calibrated value.

On special order, a relay can be provided which is equipped with an extra contact and terminal and arranged so that one circuit is closed when the voltage is below a certain value and the other circuit is closed when the voltage is above this **same** value. When the relay operates, it opens one contact and closes the other with a small delay between the two operations depending upon the setting of the time lever.

**Operating Voltage**—Each relay can be calibrated at the factory to operate at any voltage between 40 and 280 volts as ordered. This calibration is made by means of external resistors and is not subject to adjustment in operation.

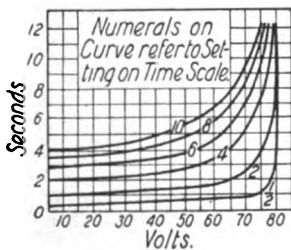
**Time Element**—Type CV relays have an inverse-time element. The time element is adjustable by means of a lever, as in type CO relays.

**Accuracy**—The accuracy of these relays is approximately five per cent.

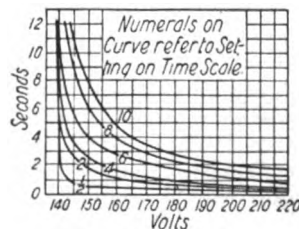
**Style number and list price** include calibrated relay complete with external resistors. Relays for 25 and 60 cycles are alike, but calibrated for the frequency on which they are to be used so that in ordering, specify **style number and frequency**.

Normal Volts	Volts at which contacts close	Style No.	List Price
110	Above 55	321027	\$40 00
110	Above 90	333713	40 00
110	Above 140	269167	40 00
110	Below 80	269165	40 00
220	Above 280	269168	40 00
220	Below 160	269168	40 00

**Approximate Dimensions**—Overall diameter, 6½ inches; depth from switchboard, 5½ inches; terminal mounting studs suitable for panels up to 2¼ inches thick.



Undervoltage Relay



Overvoltage Relay.

APPROXIMATE VOLTAGE-TIME CHARACTERISTIC CURVES

**Order by Style Number**

## TYPE CW POWER RELAYS FOR A-C. CIRCUITS



### Application

The type CW power relay was designed to act as a load-limiting device where it is desired to interrupt the circuit or give an alarm when the power flowing in a given direction exceeds a predetermined amount. For example, a mine hoist operated by an induction motor, or by direct current from a motor generator set may be protected by a type CW relay so that in case a load is descending so rapidly that an excessive amount of power is being returned to the line, the type CW relay will operate and through suitable means, cause the speed of the motor to be checked. Another use is in limiting the amount of power which may be interchanged between power houses and between different parts of a distribution system. The relay will close its contacts only when the excess power is flowing in a predetermined direction which may be either the normal or reverse direction.

The type CW relay is not intended to sectionalize distribution systems during times of trouble, because it is not sensitive enough on the low voltage condition which accompanies a short circuit.

### Operation

The type CW relay operates on the induction principle. For use on three-phase systems, relays are rated at 70 volts, and are intended to be connected in star. With such a combination, the normal voltage on each relay is usually about 65 volts, so that the amperes required to operate it varies between 0.8 and 4.6, depending upon the setting, but the current coil will carry 5 amperes continuously on any tap. For balanced loads, it is customary to use only one relay and two reactors to form an artificial neutral. Relays of this type should not have their potential coils connected in delta, be-

cause in such a case their operation will depend on the power factor of the circuits and they will not be operated by true power.

When used on a three-phase circuit, with the relays connected in star, the flow of power in the main circuit which will operate the relays is equal to the relay setting times three times the ratio of current transformers times the ratio of the voltage transformers.

Example:—Relay setting at 50 watts; the ratio of current transformer =  $\frac{800}{5} = \frac{160}{1}$ ; the ratio of voltage transformer =  $\frac{2200}{110} = \frac{20}{1}$ . Then the power flow in the main circuit equals  $50 \times 3 \times 160 \times 20 = 480000$  watts = 480 kw.

### Construction

This relay is similar to the type CO overcurrent relay, except that it has two extra terminals for the potential circuit. It has all the good features of the type CO relay, including the time scale whereby

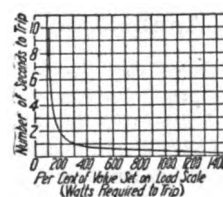


FIG. 1

its time of operation can be adjusted in proportion to the scale setting. It has an inverse-time limit, as shown by the characteristic curve in Fig. 1. The current coil has a number of taps so that the relay can be set to operate for various values as follows: 50-75-100-150-200-250-300 watts.

### Auxiliary Contacts on Circuit-Breaker

Where the relay is used to trip a circuit breaker, the latter should always be equipped with auxiliary contacts (pallet switch) to open the trip circuit, thus relieving the relay contacts of the arc which will naturally follow the opening of such an inductive circuit.

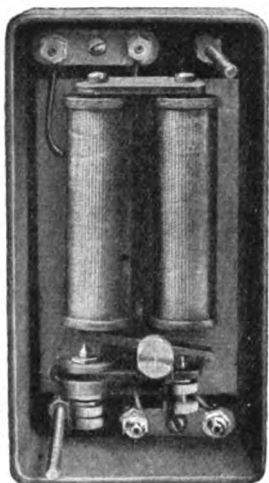
Style number and list price include relay complete, but without current or voltage transformers. Where only one relay is used on a three-phase circuit, there should be ordered one relay and two reactors which will be calibrated together, so as to assure a correct neutral point for the combination.

Volts	Watts	APPROX. WT., LBS.		STYLE No.			List Price
		Net	Boxed	25 Cycles	50 Cycles	60 Cycles	
70	50 to 300	9	18	304785	333711	304786	\$45 00
125	100 to 600	9	18	304787	333712	304788	45 00
70	volt reactor	4	10	304789	304790	304790	5 00

Approximate dimensions are: Overall diameter,  $6\frac{7}{8}$  inches; depth from switchboard,  $5\frac{1}{2}$  inches; and terminal mounting studs suitable for panels up to 2 inches thick.

Order by Style Number

## TYPE A POLARITY DIRECTIONAL RELAY FOR DIRECT-CURRENT CIRCUITS



TYPE A RELAY, COVER REMOVED

### Application

The type A polarity directional relay, used with a suitable carbon circuit breaker, will interrupt the circuit whenever its polarity may be reversed. In the production of oxygen and hydrogen, for welding purposes, by electrolytic methods, there is danger of producing an impure product, unless means are taken to prevent the electrolyzing current from accidental reversal. Standard carbon circuit breakers guard against low voltage and excessive currents and the polarity directional relay, type A, completes the protective equipment for gas cells.

This relay can be used for purposes other than protection of gas wells.

Type A relay will operate and trip the circuit breaker when any of the following conditions occur:

1. A reversal in polarity of the circuit.
2. The voltage of the circuit falls below 25 volts.
3. An open circuit in the low voltage release coil.
4. An open circuit in the relay itself.

### Distinctive Features

This relay does not require adjustment in the field.

A heavy cast iron case acts as a magnetic shield to prevent heavy short-circuit currents from weakening the permanent magnet.

Complies with rulings of the Underwriter's Laboratories for electrical equipment of Oxy-Hydrogen Plants.

Normally, the contacts are closed, thus securing the maximum reliability from the equipment.

This relay is designed for use on 125-volt circuits, but when used with an external series resistor, it may be applied to circuits of 250, 500 or 750 volts.

Will operate continuously on circuits having a voltage of 25 per cent in excess of its rating.

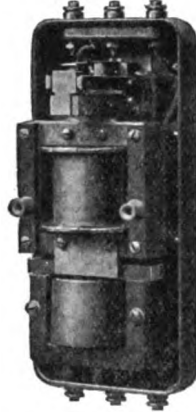
### Operation and Construction

The relay consists of a permanent magnet, a U-shaped iron magnet with a coil on each pole, and a contact-making armature. The permanent magnet, forming the base of the relay, is attached to the closed end of the electromagnet so that it gives both tips at the open end the same polarity. Current in the winding tends to produce opposite polarity in the two tips. Any current strengthens the field in one tip and weakens it in the other. The armature is pivoted acentrically, so that one pole acts on it with greater leverage than the other. When there is no voltage on the relay the long end of the armature is pulled away from the contact, thus opening the circuit. If voltage is applied in the reverse direction the contacts stay open so that the circuit breaker cannot be closed. When voltage is applied in the proper direction it weakens the pole which is pulling the contacts apart and strengthens the pole, which is pulling together, so that they close.

The operating coils of this relay are energized from the generator side of the circuit breaker and the contacts are in the low voltage release circuit, so that, upon the operation of the relay, the low voltage release coil will be de-energized and the circuit breaker will be opened.

Volts d-c.	Style No.	List Price
125	315873	\$45 00
250	315874	48 00
500	315875	52 00
750	315876	55 00

## TYPE BT TRANSFER RELAYS FOR ALTERNATING-CURRENT CIRCUITS



TYPE BT RELAY WITH COVER REMOVED

### Application

Transfer relays are used with protective relays that operate on excess current, such as type CO and type CR relays, where a direct-current trip circuit is not available. They energize the trip coil of the circuit-breaker through current transformers. While designed particularly for use with the type CO and CR relays, the type BT relay can be applied to any make of circuit-closing relay of similar characteristics.

### Distinctive Features

The breaker operates solely through the current transformer and the relays. When there is no fault on the line the trip coil of the breaker is mechanically and electrically isolated from the circuit, avoiding possibility of tripping due to imperfection in the relay contacts.

### Operation

The relay contains two series coils, an upper or operating coil and a lower or holding coil (see

diagram of connections). The holding coil holds down the armature core, until a third coil, wound on the same magnetic circuit and known as the releasing coil, is short-circuited by the protective relay. The releasing coil acts as the secondary of a transformer and when short-circuited, a current flows through it, demagnetizing the core. The holding coil, therefore, allows the operating coil to raise the core which operates the transfer switch, thus closing the trip coil circuit.

### Construction

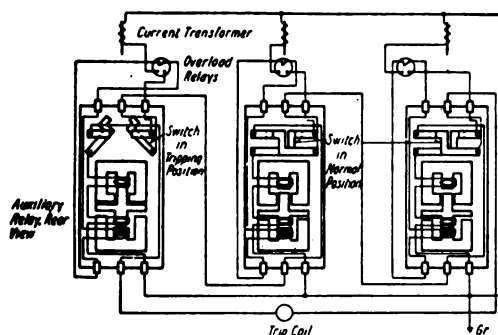
The transfer switch and other current carrying parts of the relay are designed to carry 5 amperes continuously, but during times of short-circuit the switch may be called on to handle as much as 100 or 200 amperes, which it will do satisfactorily.

### Details and Accessories

A current transformer must be selected of sufficient capacity to operate the protective relay, the transfer relay, and the trip coil. Low-ratio bushing-type current transformers sometimes used on high-voltage circuit-breakers are not suitable.

Only one trip coil is required for use on a polyphase circuit, but if the breaker is equipped with as many trip coils as there are relays, it is advisable to connect each trip coil to its corresponding relay.

Style number and list price include the type BT relay complete but without protective relays or current transformers. One type BT relay is required for each protective relay installed.



Note:—All Connections shown as viewed from Rear of Apparatus

DIAGRAM OF CONNECTIONS—TYPE BT RELAY  
ON THREE-PHASE ALTERNATING-CURRENT CIRCUIT

Capacity Amps.	APPROX. Net	WT. LBS. Boxed	Style No.	List Price
5	13	25	252725	\$35 00

Approximate Dimensions—Overall width, 4 $\frac{1}{2}$  inches; overall height, 11 $\frac{1}{2}$  inches; depth in front of switchboard, 3 $\frac{1}{2}$  inches; relay is front connected.

Order by Style Number

## TYPE D RELAYS

### REVERSE-CURRENT, OVERLOAD, AND TEMPERATURE FOR DIRECT-CURRENT CIRCUITS



#### Application

The type D reverse-current relay opens the circuit-breaker when the direction of current flow is reversed. A circuit-breaker with shunt-trip coils is required. It is particularly applicable in the protection of rotary converters, which require highly sensitive reverse-current relays to prevent running inverted.

**Limitations**—The leads should not be connected across a shunt of more than 100 millivolts at full load.

#### Operation

The relay operates on the moving coil principle. It is so connected across a shunt that the contacts are not closed except when current is reversed. The contacts close with a speed inversely proportional to the current in the coil. The controlling magnet is excited by a coil connected across the main circuit or control circuit.

#### Construction

The relay is mounted in a dust-proof metal case, suitable for rear-connected switchboard mounting.

**Adjustment**—Numbers on the adjusting scale indicate in millivolts the minimum reverse voltage at the terminals of the moving element that will cause the relay to operate.

When used on a 50-millivolt ammeter shunt a 2-millivolt tripping adjustment gives a 4 per cent sensitivity. A 100-millivolt shunt can be used to increase the sensitivity to double this value.

The contacts will close one ampere. For larger tripping currents a control relay should be interposed. An auxiliary contact should be provided on the circuit-breaker to open the tripping circuit when the breaker opens.

The time element varies from eight seconds at lowest current that will close the contacts to practically instantaneous action at high-current values.

**Overload Relays**—Overload relays of this type can be provided for a range of 40 to 80 millivolts, or any other range desired; prices on request.

**Temperature Relays**—The type D relay with special winding and contacts is used for protecting apparatus from injury due to abnormal temperatures. The Wheatstone Bridge principle is used, one arm of which is an exploring coil placed in the apparatus to be protected. It is adapted to the protection of rotating apparatus, but can be used to protect other apparatus. The operation is dependent upon the voltage of the control circuit, and is calibrated at two voltages representing the extreme limits.

The temperature-relay outfit includes the relay complete with three arms of the bridge and an auxiliary relay. The exploring coil is generally furnished with the apparatus to be protected. In ordering state resistance and temperature coefficient of search coil, control voltage, and temperature at which the relay shall operate; prices on request.

**Style number and list price** include relay without shunt. A series resistor is included with style number and list price of 200, 500 and 1500-volt relays.

#### Reverse-Current Relay

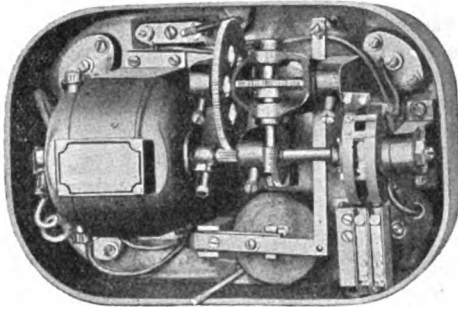
Volts	APPROX. WT., LBS.		Style No.	List Price
	Net	Boxed		
100-130	27	40	223217	\$ 94 00
200-260	27	40	223218	100 00
500-650	27	40	223219	105 00
1200-1560	27	40	223220	115 00

**Approximate Dimensions**—Overall width, 8 $\frac{1}{4}$  inches; overall height, 6 $\frac{1}{4}$  inches; depth from switchboard, 8 inches.

*Order by Style Number*



## TYPE GK LONG-TIME LIMIT, AUXILIARY RELAY



### Application

This relay is intended to control switching operations, mechanical operations and factory processes where a long-time-limit is desired. It has been used quite extensively in automatic railway substations where various operations must be correctly timed. It is made in different styles for use on any 110 volt lighting or control circuit.

### Distinctive Features

The relay is self-contained and so enclosed in a dust-proof case that it can be mounted wherever desired. The time adjustments can be changed easily and numerous combinations of contacts can be furnished on special order. The timing is quite accurate and the entire device is rugged and so designed that it can be adjusted by any careful workman. The contacts reset instantly after each operation.

### Operation

The timing is obtained by a train of gears driven by a standard Westinghouse fan motor running at a constant speed. The time is adjusted by varying the distance through which the gears must carry the movable contacts.

### Construction

The motor either a-c. or d-c. is connected through a train of gears and worms to the movable contacts. The last shaft in the train which carries the contacts is operated by a worm which is so arranged that it is normally disengaged by a spring. This worm is mounted on a trunnion and is connected to a small electro-magnet which, when it is energized, will engage the worm with the gear. This coil is usually connected in parallel with the motor winding so that as soon as the relay is energized the motor is started and the coil energized, so that the worm engages the gear and the contact starts to move. When the contacts are closed, due to the completion of the relay operation, the relay should be de-energized. This will stop the motor and release

the electro-magnet thus dis-engaging the worm and allowing the contact to return to its starting position.

If the relay is de-energized before its operation is complete the contact will immediately return to zero and the relay will be in position to start all over again in its timing operation. On the other hand, if it is desired to stop the relay and later start it again without resetting it to zero, this can be accomplished by connecting the motor and the operating coil to different circuits and keeping the operating coil energized until it is desired to return the contacts to their starting position.

The relays are rear connected with terminals suitable for mounting on a  $2\frac{1}{2}$ -inch thick panel.

**Calibration**—The standard relays listed below have a maximum time limit of 40 minutes and can be adjusted for any time less than that down to 3 minutes. On special order we can furnish relays whose total time can be adjusted from one minute up to 10 minutes, the advantage of this higher speed being that the timing will be more accurate.

**Intermediate Contact**—In addition to the main contact the standard relays listed below momentarily close an intermediate contact which can be adjusted to operate at from  $\frac{1}{2}$  to 3 minutes after the relay starts to move. If desired, relays can be furnished on special order which will make and break this momentary contact several times at predetermined fixed intervals during the travel of the relay.

**The main contact** consists of a pair of silver contacts which are bridged by the moving contact when its operation is completed. These contacts are quite rugged and will control a circuit requiring 5 or 10 amperes at 125 or 250 volts.

The standard relay as listed below must be de-energized as soon as the relay has completed its travel, otherwise the motor will continue to run and damage the contact. This is easy to accomplish usually but in case it is impossible we can provide an extra **limiting contact** which will stop the motor after the main contacts have been closed but will not de-energize the operating coil or return the contacts to their zero position.

**The style number and list price** include the relay complete, arranged to close its contacts in a maximum time of 40 minutes. The operating coil is connected in parallel with the motor so that the contact will return to zero whenever the motor is stopped. One intermediate contact is provided which will make momentary contact in a time adjustable between  $\frac{1}{2}$  and 3 minutes after the starting of the relay but no limiting contact is provided to stop the motor after the relay has completed its travel.

Volts	FREQUENCY				List Price
	D-C.	25	50	60	
110	Style No. 333379	Style No. 333380	Style No. 333381	Style No. 333382	\$400 00

**Approximate Dimensions**—7 inches high,  $10\frac{1}{2}$  inches wide by  $5\frac{3}{4}$  inches deep from the face of the panel. Approximate weight 19 lbs. net, 40 lbs. boxed.

## TYPE GR PERIODIC RECLOSING RELAY



### Application

The type GR relay is a timing relay which periodically closes three pairs of contacts to complete three independent circuits at definite time intervals which are adjustable. This relay is used to a great extent for service restoring work. In this application, the type GR relay is used to reclose periodically the circuit breaker on a feeder after it has been automatically tripped by the overload relays. The relay may be adjusted to reclose the breaker one, two or three times at fixed time intervals. The relay may be used for any application calling for the closing or opening of one or two circuits at periodic time intervals.

### Distinctive Features

The relay is mounted in a dust-proof case on a cast iron base, the whole relay being designed for vertical mounting on a switchboard panel. Connections are made inside the relay, the wires entering the panel from the rear. The cover is held in place by two thumb nuts and is easily removable for inspection of the contacts and for changing the gear ratio to obtain the various speeds of the contact drum. The contacts of this relay will close ten amperes at 100 volts and will open 1/2 ampere at 100 volts.

### Operation and Construction

The driving element of this relay is a split-phase 12-inch fan motor running at approximately 1000 rpm. Through reduction gears, this rotation is transmitted to a contact drum. This drum carries on its periphery a series of contact segments which during rotation short-circuit, for a brief period of time, several pairs of flexible contact fingers, thus completing the various contact circuits. The two final gears of the driving train are removable and

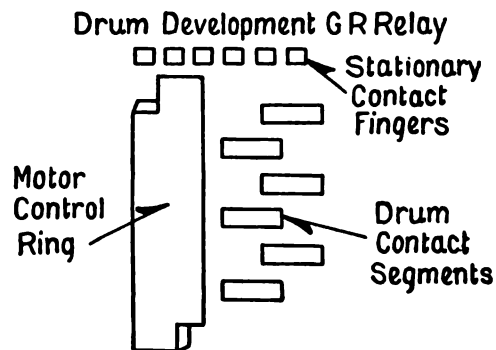
by means of an extra pair of gears, the time intervals are changed in the ratio of one, two and four. As each reclosure necessitates the energization of two separate circuits, there are actually six closing operations at equal time intervals performed by one revolution of the drum. Thus the one, two and four minute relay actually closes a circuit every half minute when the one minute gears are in use. The motor circuit is automatically controlled, if desired, by a contact ring on the drum so as to cause the drum rotation to be reversed when the opposite phase winding is energized, and stops the motor when the drum is ready for the next series of three reclosures. The ring also automatically stops the motor after the third reclosure. See drum development.

For automatically restoring service on a feeder, the operation of this relay is as follows:—The overload relay trips the breaker. The pallet switch in the open position of the breaker closes the motor circuit and causes the drum contact at the end of one (2 or 4) minutes to complete the closing circuit of the breaker and thus restore service. If the trouble no longer exists, the pallet switch of the breaker in the closed position will cause the motor to reset the periodic relay. If the trouble still persists the overload relay will again trip the breaker and the periodic relay will again close the breaker. This will be repeated for three reclosures after which the periodic relay will lock itself out and require manual resetting.

Special relays for reclosing a greater number of circuits of special time intervals can be obtained on request at an increased price.

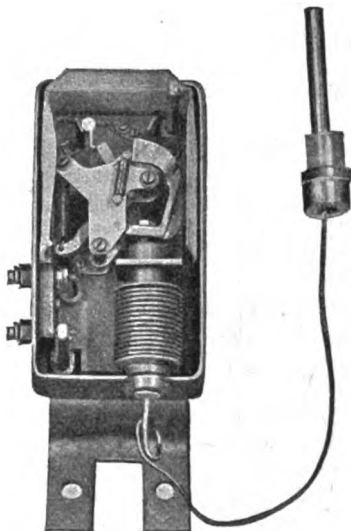
Style number and list price include relay complete with mounting bolts.

No. of Reclosures	Time Intervals in minutes between reclosures	Motor Volts	Motor Freq. Cycles	Style No.	List Price
3	1/2, 1 or 2	110	60	372415	\$375 00
3	1, 2, 4	110	60	372416	375 00
3	2, 4, 8	110	60	372417	375 00



Order by Style Number

## TYPES HM AND HN THERMOSTATIC RELAYS



THE HM RELAY FOR BEARING APPLICATION

### Application

The bearing thermostat is designed primarily for use in protecting the bearings of rotating machinery from the disastrous effects of overheating. Its use obviates the necessity of constant manual supervision, and thus is of particular value in automatic substations where there is no attending operator to take care of such an emergency as an excessively hot bearing. It may also be used to advantage for the protection of mill motors and other industrial machinery as well as for the protection of transformers in isolated locations.

The grid thermostat is designed for use in protecting the series grid resistors of automatic substations from damage by overload, due to sustained short circuits on the system. While used to a great extent in this connection, it is applicable to temperature protection in other similar capacities.

### Distinctive Features

The bulb and bellows are partially filled with a volatile liquid which vaporizes at a fairly low temperature, thus exerting a definitely increasing expansive pressure upon the bellows as the bearing temperature rises. An available pressure of several pounds at the bellows push-rod insures consistent operation of the relay contactor switch.

The grid thermostat automatically resets upon the sufficient lowering of grid temperatures, but the bearing thermostat requires manual reset, thus enforcing attention to the bearing. Otherwise the two types are similar.

As the temperature of the material in which the bulb is embedded rises, the liquid enclosed in the bulb and bellows volatilizes and thus creates a vapor pressure which expands the bellows lengthwise, thus operating the toggle switch in the relay case. If the temperature rise is sufficient the bellows will expand to a point that will cause the operation of the relay and thus set in motion the control apparatus which will relieve the condition causing the excess temperature.

The unit complete consists of a relay toggle switch and a thermostat. The switch is of standard toggle construction, ruggedly built and operated by the expansion bellows of the thermostat unit. The thermostat unit consists of a bulb, which is embedded deeply in the babbitt of the bearing within a few inches of the shaft, a connecting tube and an expansion bellows. The unit is made of copper throughout.

The operating parts, toggle switch and bellows, are mounted in a dust-proof aluminum alloy case of  $3\frac{3}{8}$  inches x 4 inches x  $7\frac{1}{8}$  inches over-all dimensions. The cover is fastened by two thumb nuts and is easily and quickly removable, thus facilitating inspection.

The general construction is of such a character that once set, the unit requires only the most nominal care.

**Finish**—The case is finished in black to match normal machine finish.

**Calibration**—The thermostat units are built and calibrated at the factory to produce a certain elongation of the bellows at a certain temperature, and are not subject to field calibration. Only minor adjustment of the set screw above the bellows push-rod is necessary to produce proper operation of the relay contactor unit.

**Contacts**—The relay contacts are rugged, easily cleaned, and of sufficient size to carry all ordinary control circuit currents.

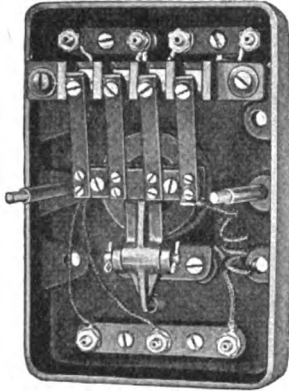
The type HM style number includes thermostat relay complete, and with bracket for mounting same on bearing pedestal.

The type HN style number includes thermostat relay complete, and with bracket for mounting same on standard 14-inch grids.

Type	Application	Operating Temperature	Tube Length	APPROXIMATE Wt., LBS.		Style No.	List Price
				Net	Boxed		
HN	Grid	150° C.	21-inch	7	20	324190	\$75 00
HM	Bearing	100° C.	21-inch	5	12	320085	70 00
HM	Bearing	100° C.	48-inch	5	12	363404	75 00

Order by Style Number

## TYPES M AND MC MULTIPLE CONTACT AUXILIARY RELAYS



TYPE M RELAY—COVER REMOVED

### Application

The type M or MC auxiliary relays are used where it is desired to trip several circuit-breakers from one type CO or other protective relay. For instance, in the differential protection of a generator, it may be desired to trip at one time the circuit-breakers connecting the generator to two bus-bars and at the same time open the field switch. One of the contacts of this relay may also be used to energize a bell alarm circuit. Each contact will make and break 10 amperes.

The type M relay is intended for intermittent duty on d-c. circuits. The type MC relay can be used for continuous duty on both a-c. and d-c.

### Construction

The type M relay is entirely enclosed in a dust-proof case and is furnished with terminal studs of sufficient length so that it can be mounted on a 2¼-inch switchboard panel. It has a black marine finish to match other switchboard instruments and it can be mounted on the front of the board, or it can be mounted on a bracket on the rear of the panel, in which case, the long terminal studs can be removed.

It is provided with a direct-current electro-magnet suitable for various voltages, and can be furnished to have either four or six contacts. Each contact is mounted on an individual phosphor bronze spring so that each circuit can be relied upon to close positively. The internal connections are such that

the current for the contacts comes in through one lead to a conducting bar on which all the contact springs are mounted. The four or six fixed contacts are all insulated from each other.

The type MC relay is provided with an electro-magnet suitable for continuous duty on either a-c. or d-c. circuits of various voltages, and can be furnished with either 3 or 6 insulated contacts. When energized, the three-contact relay makes two independent circuits and breaks one, and the six-contact relay makes five circuits and breaks one. In the case of the six-contact relay these circuits are not independent but have a common point. The construction of the contacts is similar to that of those on the type M relay, except that the breaking contacts are of silver. Silver contacts are used to insure a good contact without having an excessive amount of initial tension in the helical spring which holds the armature open.

The internal connections of the type M relay are shown in Fig. 1. This is the diagram for the four-contact relay. The diagram for the six-contact relay is exactly like it except that there are two more contacts. Figures 2 and 3 show in the internal connection of the 3 and 6-contact type MC relays respectively.

### Type M Relay

Volts d-c.	4-CONTACT RELAY		6-CONTACT RELAY	
	Style No.	List Price	Style No.	List Price
12	301858	\$24 00	304791	\$40 00
125	301856	24 00	304792	40 00
250	301857	24 00	304793	40 00

### Type MC Relay

Volts	Cycles	3-CONTACT RELAY		6-CONTACT RELAY	
		Style No.	List Price	Style No.	List Price
8	d-c.	363523	\$35 00	374992	\$50 00
12	d-c.	374985	35 00	374993	50 00
16	d-c.	372524	35 00	374994	50 00
25	d-c.	372523	35 00	374995	50 00
50	d-c.	372552	35 00	374996	50 00
125	d-c.	374986	35 00	374997	50 00
110	25	372520	35 00	374998	50 00
110	50	374987	35 00	374999	50 00
110	60	372521	35 00	375000	50 00
220	25	374988	35 00	375001	50 00
220	50	374989	35 00	375002	50 00
220	60	374990	35 00	375003	50 00
440	25	363422	35 00	375004	50 00
440	50	374991	35 00	375005	50 00
440	60	363421	35 00	375006	50 00

Approximate Dimensions and Weight—Height, 6¼ inches; depth from switchboard, 3¼ inches; width, 4-contact, 4¼ inches; 6-contact relay, 6 inches. Four-contact relay, 6¼ lbs. net, 12 lbs. boxed; 6-contact relay, 7½ lbs. net, 15 lbs. boxed.

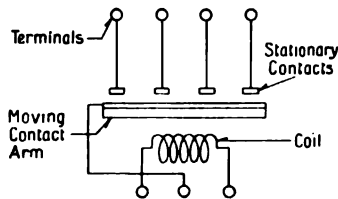


FIG. 1—WIRING DIAGRAM OF 4-CONTACT TYPE M RELAY. CONTACTS ARE SHOWN WITH THE RELAY IN THE DE-ENERGIZED POSITION

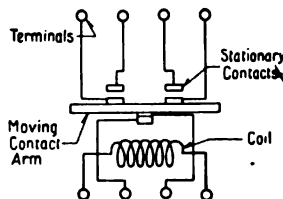


FIG. 2—WIRING DIAGRAM OF 3-CONTACT TYPE MC RELAY. CONTACTS ARE SHOWN WITH THE RELAY IN THE DE-ENERGIZED POSITION

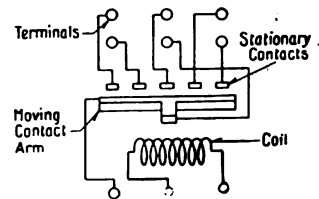
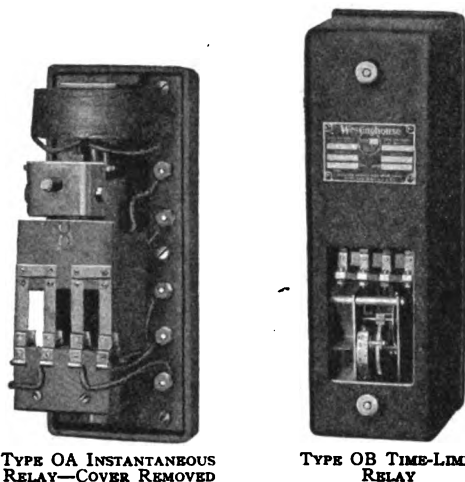


FIG. 3—WIRING DIAGRAM OF 6-CONTACT TYPE MC RELAY. CONTACTS ARE SHOWN WITH THE RELAY IN THE DE-ENERGIZED POSITION

# TYPE O AUXILIARY RELAYS

## Application

The various combinations of the type O relay known as the type OA, type OB, etc., are intended for use on miscellaneous switchboard and control work. These relays can be supplied with coils suitable for operation on circuits of various currents



from the standard relay. The contacts are quick-make and quick-break in both directions. There are no troublesome toggles in the contact assembly.

## Construction

This relay is assembled in two sizes of case. The various mechanical combinations with their type letters are shown in the accompanying figures.

Time limit is obtained by means of a train of gears and a fan. The contact will carry 2 amperes continuously and will make and break 5 amperes on a 220-volt circuit and 10 amperes on a 110-volt circuit.

These relays can be supplied with coils suitable for circuits of various voltages. Style numbers and prices on application.

## Approximate Dimensions

Time limit relay 10 7/8 inches high by 3 5/8 inches wide, by 5 1/4 inches depth from the face of the board. Instantaneous relays 8 1/4 inches high by 3 5/8 inches wide by 5 1/4 inches depth from the board.

and voltages, both a-c. and d-c. and will control various combinations of circuits. They are made in both the instantaneous and time limit form, the latter being capable of adjustment from 0 up to 10 seconds.

The type O line of relays supersedes the type KN relay listed in previous editions of this catalogue.

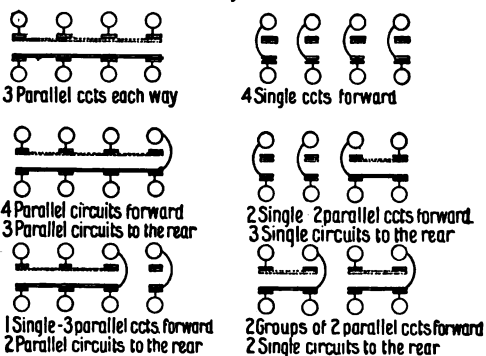
## Distinctive Features

The type O relays are dust-proof, occupy small switchboard space and to a large extent make use of interchangeable parts. The time limit can easily be adjusted to operate either on the up-stroke or down-stroke of the plunger or both. The contacts are of chemically pure silver and something like 25 different combinations of circuits can be made



Connections as Shipped—Two Separate Circuits Each Way.

Some of the numerous other possible contact combinations which can be made after the relay is installed



CONTACT COMBINATIONS FOR TYPE O RELAYS

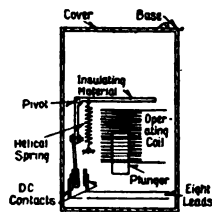


FIG. 1—RELAY WITH AUTOMATIC RESET

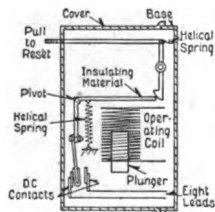


FIG. 2—RELAY WITH HAND RESET

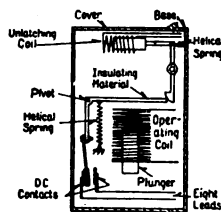


FIG. 3—RELAY WITH UNLATCHING COIL

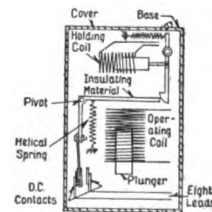


FIG. 4—RELAY WITH HOLDING COIL

Instantaneous.....  
Time Limit.....

OPERATING COIL ONLY  
Automatic Reset  
Fig. 1  
Type OA  
Type OB

Hand Reset  
Fig. 2  
Type OL  
Type OM

OPERATING AND AUXILIARY COIL  
Holding Coil  
Fig. 3  
Type OS  
Type OT

Unlatching Coil  
Fig. 4  
Type OX  
Type OY

## TYPE CM PHASE-BALANCE CURRENT RELAY



### Application

The phase-balance current relay is designed to protect polyphase converters, motors, etc., against operating single-phase.

### Operation

This relay consists of four single-phase current elements mounted in a single case. There are two separate discs, each with its own contacts and each actuated by two current elements, which are mounted face to face on opposite sides of the disc. These elements are so connected that an electrical torque of one element opposes that of the other, thus producing balanced mechanical torques on the relay disc, when electrical conditions are

balanced, that is, with equal loads on all phases. Each phase is protected since all three phases of the line are represented in the relay. One element of one disc is connected in series with one element of the other disc. Thus the "A" phase may balance the "B" phase on the upper disc, and the "B" phase balance the "C" phase on the lower disc.

Therefore it can be seen that if any one phase becomes opened, or overloaded, it will unbalance the mechanical torques of the relay and one or more pairs of the contacts will be closed.

These relays are ordinarily furnished with three current taps per phase for 2-4-6 amperes; thus with all elements set on the two-ampere current tap, the relay will close its contacts under the following conditions: (1.) With 2 amperes in one phase and zero amperes in either of the other phases. (2.) With 2 amperes in one phase and 4 or more amperes in either or both of the other phases. (3.) This relay has an inverse-definite-time curve, the maximum definite time being about 0.25 second.

Style number and list price do not include a contactor switch, which is necessary only when the current to be handled by the relay exceeds 5 amperes. If a contactor switch is desired, specify "same as style number, . . ." except to have contactor switch.

3-phase*	110-VOLT	
Frequency	Style No.	List Price
25 cycles	324051	\$175 00
60 cycles	324052	175 00

\*This relay can also be supplied for a 2-phase circuit. Prices upon application.

## TYPE S SHORT-CIRCUIT SELECTIVE RELAY

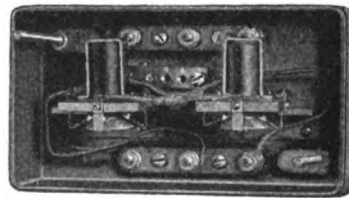
### Application

The type S relay is used on direct-current systems, both 2-wire and 3-wire to disconnect a feeder whenever a short circuit occurs. This relay will work only upon the occurrence of a short circuit and will not operate due to overload no matter how heavy such an overload may be. It is frequently used in automatic d-c. substations, particularly in connection with automatic reclosing breakers.

### Operation

The type S relay is connected to the secondary circuit of a current transformer, the primary of which is connected to the feeder which is to be protected. Whenever the current in the d-c. circuit is suddenly increased, there will be a corresponding rush of current in the secondary circuit of the transformer which will operate the main coil of the relay. This rush of current of course does not last long, nevertheless the main electro-magnet of the relay will respond to it. In order to make sure that this short impulse will trip the circuit-breaker to which the relay is connected an additional contactor switch is included in the tripping circuit. This switch is wound with a 15-volt coil and so arranged that when it is energized by the main coil of the relay it will close its contacts and hold them closed until the circuit-breaker opens.

It is usually recommended that the type S relay be connected to a current transformer having approximately twice the current rating of the d-c. feeder. The current which will operate this relay is not a definite amount but depends upon the suddenness with which the short circuit occurs. During an actual test on an 800-ampere feeder equipped with a 1600-ampere current transformer and with the relay set on the 4-ampere tap the relay operated when 1200 amperes was suddenly applied to the feeder.



TYPE S RELAY—COVER REMOVED

Style number and list price include relay only without current transformers.

2 wire	Style No.	List Price
3 wire	383418	\$30 00
	375009	35 00

Approximate dimensions, height 4 inches, width 7½ inches, depth from switchboard 3¼ inches. Approximate net weight, 3 pounds. Approximate boxed weight 8 pounds.

# TYPE R SERVICE-RESTORING RELAY SYSTEM FOR ALTERNATING-CURRENT CIRCUITS

## Application

This system of relays is used on overhead primary feeders to decrease the number of interruptions caused by lightning and similar disturbances. Many of these disturbances are transient in character so

limiting relay. As will be seen by reference to Fig. 2 the limiting relay short circuits the restoring relay and thus prevents further operation.

The restoring relay can be disconnected by opening a double-pole knife switch which is so arranged as to open the a-c. and d-c. control circuits.

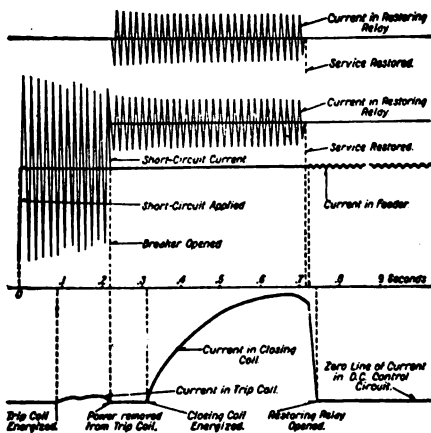


FIG 1.—Oscillograph Records Showing Operation of Service-Restoring Relay System on a Transient Short Circuit.

that, although they cause short circuits which trip open the power house circuit-breaker, the feeder is undamaged and can be immediately replaced in service. The type R restoring system was developed to automatically reclose the breaker as soon as it has been opened by a short circuit.

## Operation

The restoring relay, which will operate with any type of overload relay, is connected between two potential transformers, one of which is placed on the bus-bars and the other on the feeder outside the circuit-breaker. As soon as the breaker is opened and the arc has cleared, the bus-bar transformer will force current through the feeder transformer and through the restoring relay which will instantly reclose the breaker. The device works so rapidly that the service can be restored before one second has elapsed after the occurrence of the short circuit. The lighting customers on the feeder are not inconvenienced except by a momentary "blink" of the lights and motors will very easily continue in motion through the short interruption.

If the feeder should be permanently short-circuited it will continue to be alternately opened and closed until further reclosing is prevented by the

## Construction

The restoring relay is similar to the type 20-F Contactor, and is protected by a metal cover. It is mounted on a small, black, marine-finished, slate panel with its series resistance and cutout switch. The limiting relay is similar to the type CV Relay, except that it is more sluggish in its operation. This type of limiting relay is recommended because it resets itself automatically. It can be adjusted so that it will allow the restoring relay to operate from one to four times on a single case of trouble, and will prevent further operation of the restoring relay if the trouble persists after the predetermined number of trials have been made. If the trouble clears so that the breaker will stay closed before all the allowable trials have been made, the limiting relay will reset itself so that the next time trouble occurs the reclosing relay can operate as at first.

## Auxiliaries

In order that the breaker will not reclose after it has been opened by hand, it is desirable to use a special control switch Style No. 294459 which is so arranged that it will open the control circuit of the restoring relay whenever the breaker is opened by hand. It is desirable to keep a record of the operation of the restoring device, and for this purpose we recommend a d-c. type U recording ammeter connected in the control circuit. Every time the control circuit is energized by the closing relay the ammeter will make a single swing across the chart.

Style number and list price of the restoring relay include the series resistance, knife switch and panel.

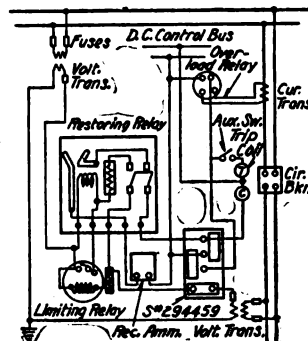


FIG. 2.—Complete Diagram of Connections of Service-Restoring Relay System.

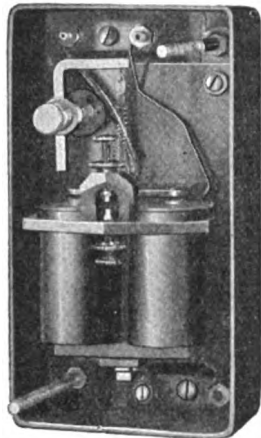
	APPROX. WEIGHT, LBS.		Style No.	List Price
	Net	Boxed		
Restoring Relay, 110 volts, 25 or 60 cycles	22	35	304822	\$25 00
Limiting relay with resistor, 110 volts, 25 or 60 cycles	10	20	253422	40 00
Control Switch	..	..	294459	18 00

Approximate dimensions— Restoring relay, size panel, 14 inches high, 12 wide; 1 inch thick. Depth of relay on panel, 5 inches. Limiting relay, overall diameter, 6 7/8 inches, depth from switchboard, 5 7/8 inches.

Order by Style Number

# TYPES TO OVERCURRENT AND TV OVERVOLTAGE RELAYS

## FOR DIRECT-CURRENT CIRCUITS



### Application

Type TO relays are used particularly with three-wire generators that have but two cables running to the switchboard. The circuit-breakers can be mounted on the switchboard, and controlled by the actual current in the neutral lead which is required by the Fire Underwriters, by means of the TO relay, the control coil of the relay being connected to the ammeter shunts.

The Type TV relays are used for overvoltage and undervoltage protection of d-c. circuits.

### Distinctive Features

The relays TO and TV are fully enclosed and easily mounted on the front or rear of the board. Adjustment is simple and the calibration is satisfactory as to accuracy. The TO relay can be used with a standard 50-millivolt ammeter shunt, the same shunt that is used with the ammeter, without affecting the readings of the ammeter.

### Operation

The pull of the relay coils is opposed by a helical spring. When the pull exceeds the tension of the spring the contacts close. A calibrated adjustable arm is used to adjust the tension of the spring to regulate the voltage at which the contacts will close.

### Construction

The operating part of the relay is a small two-pole electro-magnet with special winding. This and the adjusting mechanism are enclosed in a dust-proof case of aluminum alloy. The cover is fastened by two thumb nuts and is easily removed for inspecting or adjusting the relay.

**Finish**—The case is finished in black marine to match the standard switchboard finish. Internal metal parts are polished and lacquered brass.

Standard type TV overvoltage relays are calibrated to close the contacts when the voltage rises

to the value at which the relay is set to operate. There are two overvoltage relays, one calibrated to close contacts at from 80 to 160 volts, the other is calibrated to close contacts at from 160 to 320 volts. The type TV undervoltage relays are calibrated to close the contacts when the voltage drops to the value at which the relay is set to operate. One of these relays is calibrated to close the contacts at from 50 to 90 volts, the other is calibrated to close the contacts at from 100 to 180 volts.

Two style numbers for uncalibrated TV relays are listed. These relays are recommended for all applications requiring a special calibration, as they can be very easily and more satisfactorily calibrated in connection with the apparatus with which they are to be used. Relay style number 356914 can be calibrated as an overvoltage relay from 80 to 180 volts. By merely interchanging the stationary contact and the contact stop, the above style number relay can be used to close a circuit when the voltage drops (undervoltage relay). As an undervoltage relay its operating range is from 50 to 90 volts. Relay style number 356915 is similar to the above except that its range as an overvoltage relay is from 180 to 360 volts, and its range as an undervoltage relay is 100 to 180 volts.

**Calibration**—Standard type TO relays are calibrated for adjustment to close contacts at from 40 to 80 millivolts, corresponding to 80 to 160 per cent of full load.

**Auxiliary Contacts on Circuit-Breaker**—Where a relay is used, the circuit-breaker should have auxiliary contacts to open the trip circuit when the breaker opens, relieving the relay contacts of the duty.

**Contacts**—The relay contacts will close 1 ampere. When the circuit-breaker trip coil requires more than this, a control relay should be used. For information as to the current required by circuit-breaker shunt-trip coils and for description of control relays see catalog sections 1-C and 2-B respectively.

**Time Element**—The type TO and TV relays are instantaneous in operation.

**Style number and list price** include relay without ammeter shunt or leads. For shunts see pages on "Ammeter Shunts." Leads should have a resistance of approximately .04 ohm.

Type	Calibration	Style No.	Price
TO—Overcurrent	40 to 80 Millivolts	221738	\$32 00
TV—Overvoltage	80 to 160 Volts	375023	45 00
TV—Overvoltage	160 to 320 Volts	375024	45 00
TV—Undervoltage	50 to 90 Volts	375021	45 00
TV—Undervoltage	100 to 180 Volts	375022	45 00
TV—{Overvoltage or Undervoltage}	Uncalibrated	356914	45 00
TV—{Overvoltage or Undervoltage}	Uncalibrated	356915	45 00

Approximate weight; Net 3 pounds, boxed 8 pounds.  
Dimensions—Over-all height 8 inches; width 4 inches; depth from switchboard 3 1/4 inches.

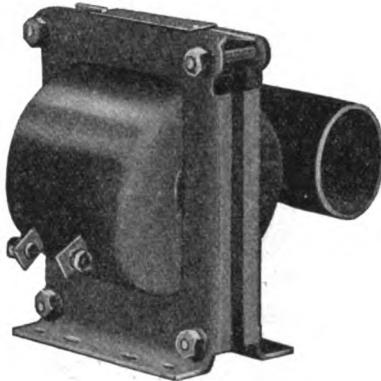


# CURRENT TRANSFORMERS

## TYPE K (DRY TYPE) INDOOR

Rated Voltage { 4600, Two-Wire  
1150, Three-Wire

For 25 to 133-Cycle Circuits. Capacity, 25 Volt-Amperes, Compensated for 12½ Volt-Amperes



TWO-WIRE, TYPE K

**Two-Wire**—The type K two-wire transformers comprise a line of low-priced transformers of good accuracy, available over a wide range of application. This type is listed for ammeter, wattmeter, or watt-hour meter use, but may also be used for operating relays and circuit-breaker trip coils where the load at 4 amperes does not exceed 25 volt-amperes at 25 cycles or 65 volt-amperes at 60 cycles. They should not be used with relays where the circuit-breaker trip coil is connected in series with the relay. As shown in the illustration, the transformers are arranged with the primary leads on opposite ends of the coil, an arrangement well adapted for general service conditions, including switchboard mounting.

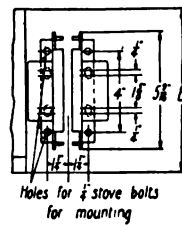


FIG. 1—APPROXIMATE DIMENSIONS OF TWO-WIRE

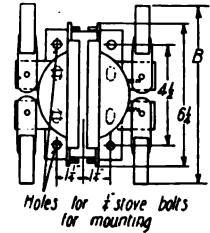


FIG. 2—APPROXIMATE DIMENSIONS OF THREE-WIRE

**Three-Wire Type K**—Designed for use with watt-hour meters on three-wire distribution systems. The primary consists of two separate windings, one of which is connected in each outside wire of the three-wire system, and the secondary winding is connected to the watt-hour meter. When so connected, the watt-hour meter measures the total output of the system. The ampere rating refers to the current in the outside wires.

AMPERES		Fig.	DIMENSIONS				Bore of Term. Inches†	APPROX. Wt., LBS.		Style No.	List Price
Primary	Secondary		A	B	C	D		Net	Boxed		
<b>TWO-WIRE</b>											
5	5	1	5½	...	6½	3¼	0.186	10	18	303881	\$19 00
10	5	1	5½	...	...	...	0.186	10	18	303882	19 00
15	5	1	5½	...	...	...	0.186	10	18	303883	19 00
25	5	1	5½	...	...	...	0.259	10	18	303884	19 00
50	5	1	6	...	...	...	0.384	10	18	303885	19 00
75	5	1	6	...	...	...	0.384	10	18	303886	19 00
100	5	1	6½	6½	...	...	0.558	10	18	303887	19 00
150	5	1	6½	6½	...	...	0.558	10	18	303888	19 00
200	5	1	6½	8½	...	...	0.745	10	18	303889	20 00
300	5	1	6½	8½	...	...	0.745	10	18	303890	22 00
400	5	1	7½	8½	...	...	0.745	10	18	303891	23 00
500	5	1	7½	8½	...	...	0.745	10	18	303892	25 00
750	5	..	8½	9¼	7½	3½	0.918	14	22	303893	28 00
1000	5	..	9¼	12½	7½	3½	1.120	17	25	303894	30 00
<b>THREE-WIRE</b>											
5*	5	2	5½	...	...	...	0.186	10	18	303869	20 00
10*	5	2	5½	...	...	...	0.186	10	18	303870	20 00
15*	5	2	5½	...	...	...	0.186	10	18	303871	20 00
25*	5	2	5½	...	...	...	0.259	10	18	303872	20 00
50*	5	2	5½	...	...	...	0.384	10	18	303873	20 00
75*	5	2	5½	...	...	...	0.384	10	18	303874	20 00
100*	5	2	5½	...	...	...	0.558	10	18	303875	20 00
150*	5	2	5½	...	...	...	0.558	10	18	303876	20 00
200*	5	2	6	7½	...	...	0.745	10	18	303877	21 00
300*	5	2	6	7½	...	...	0.745	10	18	303878	23 00
400*	5	..	6½	7	...	...	0.918	11	19	303879	24 00
500*	5	..	6½	8½	...	...	1.120	14	22	303880	26 00

\*Current in outside wires.

†These dimensions are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number

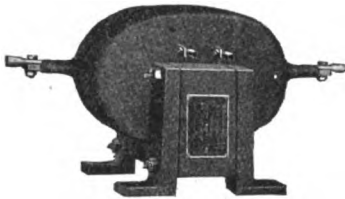
CURRENT TRANSFORMERS—Continued

TYPE KA (DRY TYPE) INDOOR

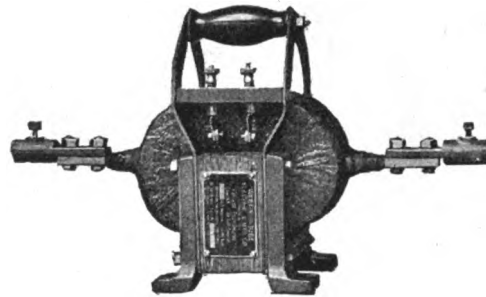
Rated Voltage 6900†. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes



SWITCHBOARD TYPE KA



SEMI-PORTABLE TYPE KA

A high degree of accuracy in the ratio of primary to secondary current and a minimum phase displacement error are obtained in type KA transformers. This type is recommended for indoor use in all cases where highest accuracy is required.

As shown in the illustrations, the transformers are arranged with the primary leads on the opposite ends of the coils, an arrangement well adapted for

switchboard use. Lugs are provided for mounting purposes.

Portable Type KA—In the ordinary form of portable current transformer, extreme accuracy is sacrificed to obtain portability and convenience of application. The type KA semi-portable transformer is the standard type KA fitted with a special carrying handle and terminals as shown above.

AMPERES	Dimension†		Bore of Terminals Inches*	SWITCHBOARD TYPE			SEMI-PORTABLE TYPE					
	Pri-ary	Sec-ond-ary		Fig.	Inches	Net	Boxed	Style No.	List Price	Net	Boxed	Style No.
5	5	1	12 1/4	.186	24	44	125000	\$38 00	28	48	269929	\$45 00
10	5	1	12 1/2	.186	24	44	125001	38 00	28	48	269930	45 00
15	5	1	12 1/2	.186	24	44	125002	38 00	28	48	269931	45 00
25	5	1	12 1/2	.259	24	44	180642	38 00	28	48	269933	45 00
50	5	1	12 1/2	.334	24	44	180643	38 00	28	48	269936	45 00
75	5	1	13	.334	25	45	227058	38 00	28	48	269938	45 00
100	5	1	16 1/4	.432	27	47	125008	38 00	31	51	269940	45 00
150	5	1	16 1/4	.558	27	47	180644	39 00	31	51	269942	46 00
200	5	1	16 1/2	.745	27	47	125011	40 00	31	51	269944	47 00
300	5	1	17	.745	27	47	125013	42 00	31	51	269946	49 00
400	5	1	18 1/4	.918	27	47	125014	43 00	31	51	269947	50 00
500	5	1	18 1/2	1.12	27	47	125015	44 00	..	..	..	..
750	5	1	17	2(.918)	30	50	305238	46 00	..	..	..	..
1000	5	2	19 3/4	2(1.12)	30	50	125018	52 00	..	..	..	..

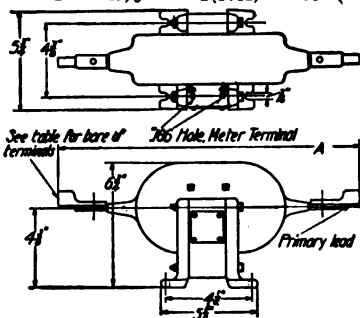


FIG. 1—APPROXIMATE DIMENSIONS\* OF TYPE KA Style Nos. 125015 to 125016, 180644 and 305238 have their leads staggered off center line. On these styles, distance between center line of coil and center line of terminal is approximately 1/4 of an inch.

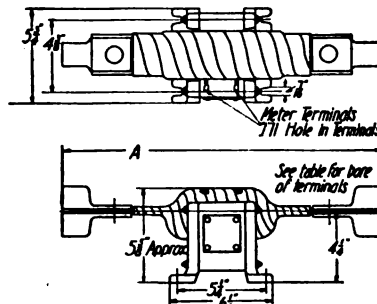


FIG. 2—APPROXIMATE DIMENSIONS\* OF TYPE KA

\*Dimensions shown are for switchboard type; semi-portable type are same except that handle and longer terminals are added. These dimensions are for reference only. For official dimensions apply to the nearest district office.

†This particular line of transformers, due to exceptional design, can be operated on lines as high as 8000 volts maximum.

Order by Style Number

CURRENT TRANSFORMERS—Continued

TYPE MA (DRY TYPE) OUTDOOR

Rated Voltage 6900†. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes

These transformers are mounted in cast iron end caps with the leads extending downwards through suitable bushings. The transformers are impreg-

nated with an insulating compound which thoroughly seals up joints between the laminations and end caps.



AMPERES		Dimensions Fig.	Dimension A Inches*	Bore of Terminals Inches*	APPROX. WT., LBS.		Style No.	List Price
Primary	Secondary				Net.	Boxed		
5	5	1	30 1/4	.259	60	80	242300	\$55 00
10	5	1	30 1/4	.259	60	80	242301	55 00
15	5	1	30 1/4	.259	60	80	242302	55 00
25	5	1	30 1/4	.259	60	80	242304	55 00
50	5	1	30 1/4	.384	60	80	242307	55 00
75	5	1	30 1/4	.384	60	80	242309	60 00
100	5	1	30 1/4	.432	60	80	242311	60 00
150	5	2	24 1/2	.558	70	95	242313	65 00
200	5	2	24 1/2	.745	70	95	242315	65 00
300	5	2	25 1/4	.75	70	95	242317	65 00
400	5	2	25 1/4	.937	70	95	242318	65 00
500	5	2	26	1.125	70	95	242319	65 00

Style No.	Description	List Price
109712	Set of two Hanger Irons for Type MA transformer.....	\$ 1 50

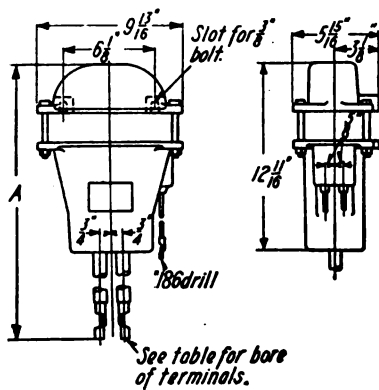


FIG. 1—APPROX. DIMENSIONS\* OF TYPE MA

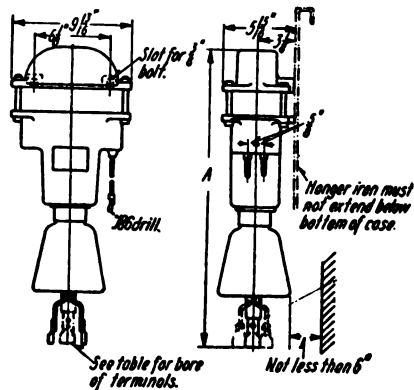


FIG. 2—APPROX. DIMENSIONS\* OF TYPE MA

\*These dimensions are for reference only. For official dimensions apply to the nearest District Office.

†This particular line of transformers, due to exceptional design, can be operated on lines as high as 8000 volts maximum.

Order by Style Number

CURRENT TRANSFORMERS—Continued

TYPE KB (DRY TYPE) INDOOR

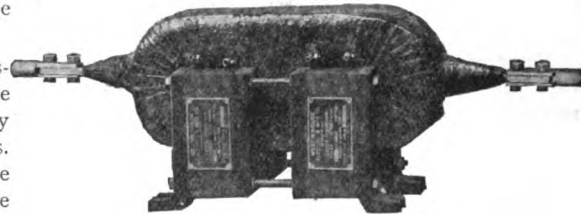
Rated Voltage 13,800†. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes

These transformers are similar to the type KA, except for the higher voltage rating.

**Double-Secondary Type KB**—These transformers are similar in construction and voltage rating, but have two independent secondary windings, each compensated for 25 volt-amperes. One of these transformers therefore takes the place of two ordinary transformers on the same line.



DOUBLE-SECONDARY TYPE KB

AMPERES		Dimensions Fig.	Dimension A Inches*	Bore of Terminal Inches†	APPROX. WT. LBS.		Style No.	List Price
Primary	Secondary				Net	Boxed		
<b>Single Secondary</b>								
5	5	2	16 5/8	.186	31	51	125019	\$51 00
10	5	2	16 5/8	.186	31	51	125020	51 00
15	5	2	16 5/8	.186	31	51	125021	51 00
25	5	2	16 5/8	.259	31	51	180646	51 00
50	5	2	17	.384	31	51	180647	51 00
75	5	2	18	.384	32	52	227059	51 00
100	5	2	18 5/8	.558	34	54	125027	51 00
150	5	2	18 5/8	.558	34	54	180648	53 00
200	5	2	19	.745	34	54	125030	55 00
300	5	2	20 7/8	.745	34	54	125032	56 00
400	5	2	21 3/8	.918	34	54	125033	57 00
500	5	2	22 5/8	1.12	34	54	125034	56 00
750	5	2	21 3/8	2 (.918)	34	54	305239	60 00
1000	5	2	23 1/4	2 (1.25)	38	58	288926	63 00
1500	5	2	23 1/4	2 (1.25)	40	60	288990	66 00
<b>Double Secondary</b>								
5	5+5	1	22 3/4	.259	55	80	182796	80 00
10	5+5	1	22 3/4	.259	55	80	182797	80 00
15	5+5	1	22 3/4	.259	55	80	182798	80 00
25	5+5	1	22 3/4	.259	55	80	182800	80 00
50	5+5	1	23 1/8	.384	55	80	182803	80 00
75	5+5	1	23 1/4	.384	55	80	245482	80 00
100	5+5	1	25 1/4	.558	58	83	182806	80 00
150	5+5	1	25 1/4	.558	58	83	182808	90 00
200	5+5	1	25 1/4	.558	58	83	182810	95 00
300	5+5	1	26 5/8	.745	58	83	182812	100 00
400	5+5	1	27 1/2	.918	58	83	182813	105 00
500	5+5	1	28 3/2	1.12	58	83	182814	110 00
750	5+5	1	26 1/4	2 (.918)	58	83	305240	115 00
1000	5+5	1	27 1/4	2 (1.12)	60	85	288991	120 00

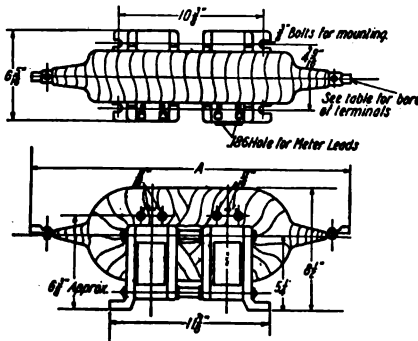


FIG. 1—APPROX. DIMENSIONS\* OF DOUBLE-SECONDARY TYPE KB. (Styles Nos. 182806 to 182814 and 305240 have their leads staggered off center line similar to Fig. 2) In the transformers, which have the primary leads staggered, the distance between the center line of the coil and the center line of the terminal is approximately 1/4 of an inch.

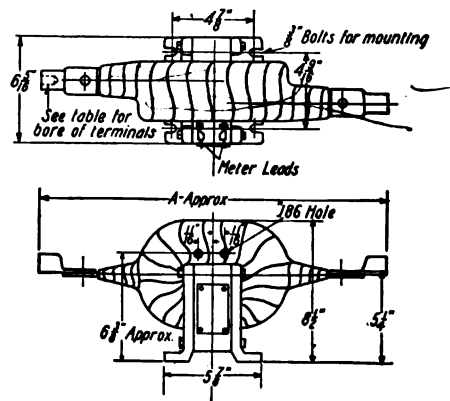


FIG. 2—APPROX. DIMENSIONS\* OF SINGLE-SECONDARY TYPE KB. (Style Nos. 125019 to 125021, 180646, 180647 and 227059 have their leads on center line similar to Fig. 1)

†This particular line of transformers, due to exceptional design, can be operated on lines as high as 17000 volts maximum.  
\*These dimensions are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number

CURRENT TRANSFORMERS—Continued

TYPE MB (DRY TYPE) OUTDOOR

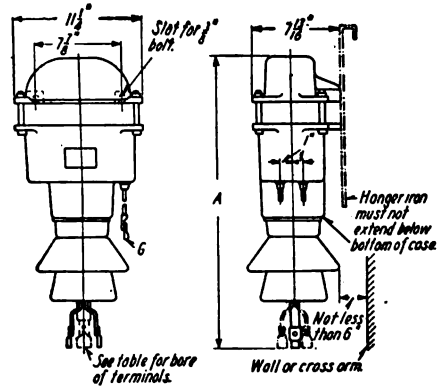
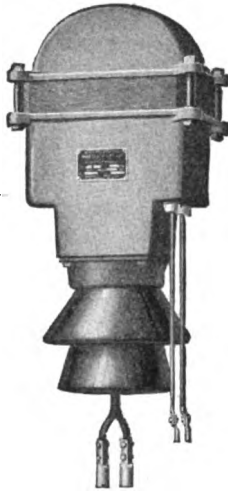
Rated Voltage 13,800†. Transformers Will Operate Satisfactorily at Voltages up to 5 per cent Above This Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes

These transformers are mounted in cast iron end caps with the leads extending downwards through suitable bushings. The transformers are impreg-

nated with an insulating compound which thoroughly seals up joints between the laminations and end caps.



AMPERES		Dimension A Inches*	Bore of Terminals*	APPROX. WT., LBS.		Style No.	List Price
Primary	Secondary			Net	Boxed		
5	5	29	.259	90	115	242320	\$100 00
10	5	29	.259	90	115	242321	100 00
15	5	29	.259	90	115	242322	100 00
25	5	29	.259	90	115	242324	100 00
50	5	29	.384	90	115	242327	100 00
75	5	29	.384	90	115	242329	100 00
100	5	27 1/2	.432	90	115	242331	100 00
150	5	27 1/2	.558	90	115	242333	100 00
200	5	27 1/2	.745	90	115	242335	110 00
300	5	28 3/4	.745	90	115	242337	110 00
400	5	28 1/2	.937	90	115	242338	110 00
500	5	28 3/4	1.125	90	115	242339	110 00

AMPERES		Secondary	Double Primary Style No.	List Price
Primary	Secondary			
5 or 10	5	5	369263	\$110 00
10 or 20	5	5	369264	110 00
15 or 30	5	5	293485	110 00
25 or 50	5	5	332508	110 00
50 or 100	5	5	309720	110 00
75 or 150	5	5	293487	110 00
100 or 200	5	5	369265	120 00
150 or 300	5	5	358705	120 00

Hanger Irons

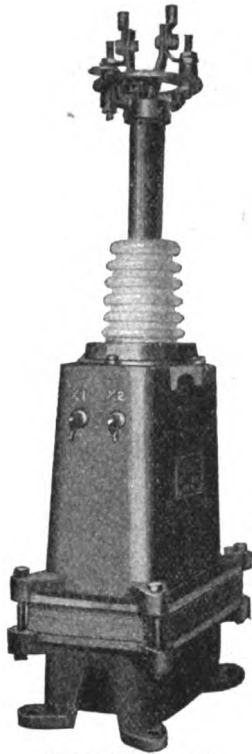
Style No.	Description	List Price
109712	Set of hanger irons for type MB transformer	\$1 50

\*These dimensions are for reference only. For official dimensions apply to the nearest District Office.

†This particular line of transformers, due to exceptional design, can be operated on lines as high as 17,000 volts maximum.

Order by Style Number

CURRENT TRANSFORMERS—Continued



SINGLE SECONDARY

TYPE KC (DRY TYPE) INDOOR

Rated Voltage 23,000. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes

Type KC—Mounted in cast iron end caps which are filled with insulating compound. This construction insures ample insulation between the high voltage winding and the secondary winding or the core.

Double Secondary Type KC—Similar in construction and voltage rating to the type KC, but have two independent secondary windings, each compensated for 25 volt-amperes. One of the transformers, therefore, takes the place of two ordinary transformers on the same circuit.

A spark gap across the primary winding protects the winding from surges.

AMPERES Pri- Secondary	Dimen- sions Fig.	Dimen- sion A Inches†	Bore of Terminals Inches†	APPROX. WT., LBS. Net. Boxed	Style No.	List Price
<b>Single Secondary</b>						
5	5	1	36 1/2	.558 112 142	182756	\$100 00
10	5	1	36 1/2	.558 112 142	182757	100 00
15	5	1	36 1/2	.558 112 142	182758	100 00
				.558		
25	5	1	36 1/2	.558 112 142	182760	100 00
50	5	1	36 1/2	.558 112 142	182763	100 00
				.558		
75	5	1	36 1/2	.558 112 142	242299	100 00
100	5	1*	39 1/2	.558 116 146	182766	100 00
				.558		
150	5	1*	39 1/2	.558 116 146	182768	100 00
200	5	1*	39 1/2	2(.558) 116 146	182770	100 00
				.558		
300	5	1*	39 1/2	2(.558) 116 146	182772	100 00
400	5	1*	39 1/2	2(.745) 116 146	182773	100 00
500	5	1*	39 1/2	2(.745) 116 146	182774	100 00

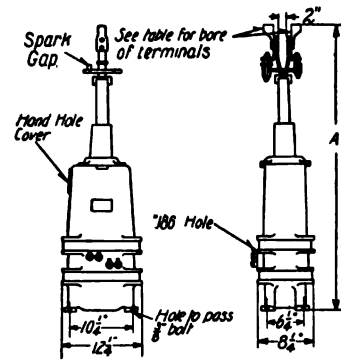


FIG. 1—APPROX. DIMENSIONS† OF SINGLE SECONDARY

<b>Double Secondary</b>						
5	5+5	2‡	41 1/4	.558 160 190	182776	130 00
10	5+5	2‡	41 1/4	.558 160 190	182777	130 00
15	5+5	2‡	41 1/4	.558 160 109	182778	130 00
				.558		
25	5+5	2‡	41 1/4	.558 160 190	182780	130 00
50	5+5	2‡	41 1/4	.558 160 190	182783	130 00
				.558		
75	5+5	2‡	41 1/4	.558 160 190	242579	130 00
100	5+5	2	43 3/4	.558 165 195	182786	130 00
				.558		
150	5+5	2	43 3/4	.558 165 195	182788	130 00
200	5+5	2	43 3/4	2(.558) 165 195	182790	130 00
				.558		
300	5+5	2	43 3/4	2(.558) 165 195	182792	130 00
400	5+5	2	43 3/4	2(.745) 165 195	182793	130 00
500	5+5	2	44 3/4	2(.745) 165 195	182794	130 00

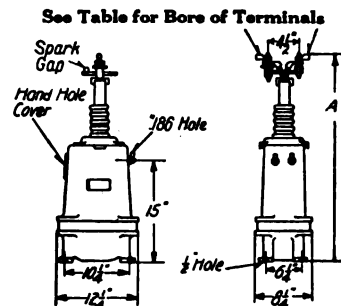


FIG. 2—APPROX. DIMENSIONS† OF DOUBLE SECONDARY

\*Primary terminal arrangement as per Fig. 2  
 †These dimensions are for reference only. For official dimensions apply to the nearest District Office.  
 ‡Primary terminal arrangement as per Fig. 1

Order by Style Number

3-396A

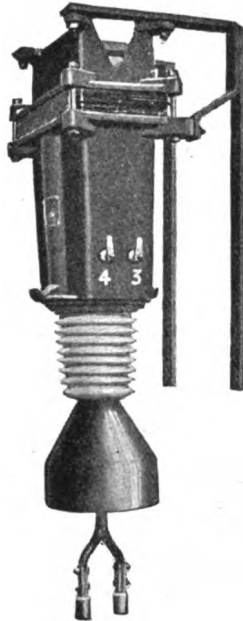
CURRENT TRANSFORMERS—Continued

TYPE MC (DRY TYPE) OUTDOOR

Rated Voltage 23,000. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

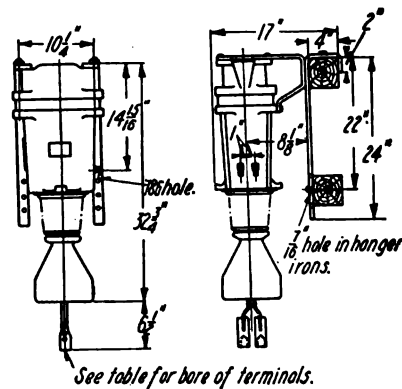
Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes



TYPE MC WITH HANGER IRONS

(Hanger Irons Not Included in Style Number and Price.)

These transformers are mounted in cast iron end caps with the leads extending downwards through suitable bushings. The transformers are impregnated with an insulating compound which thoroughly seals up joints between the laminations and end caps. A spark gap across the primary winding protects the winding from surges.



APPROX. DIMENSIONS\* OF TYPE MC

Primary	AMPERES		Bore at Terminals*	APPROX. WT., LBS.		Style No.	List Price
	Secondary			Net	Boxed		
5	5		.384	125	155	2423340	\$175 00
10	5		.384	125	155	2423341	175 00
15	5		.384	125	155	2423342	175 00
25	5		.384	125	155	2423344	175 00
50	5		.384	125	155	2423347	175 00
75	5		.384	125	155	2423349	175 00
100	5		.558	125	155	2423351	175 00
150	5		.558	125	155	2423353	175 00
200	5		2(.558)	125	155	2423355	175 00
300	5		2(.558)	125	155	2423357	175 00
400	5		2(.745)	125	155	2423358	175 00
500	5		2(.745)	125	155	2423359	175 00

Hanger Irons

Style No.	Description	List Price
242576	Set of two Hanger Irons for type MC Transformer.....	\$12 00

\*These dimensions are for reference only. For official dimensions apply to the nearest District Office

Order by Style Number

CURRENT TRANSFORMERS—Continued

THROUGH-TYPES FS AND FB (DRY TYPE) INDOOR

Rated Voltage 2300, Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits



TYPE FS



TYPE FB

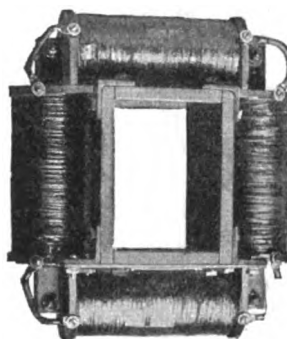
Except the 7500 and 10,000-ampere sizes these transformers have a potential rating of 2300 volts. By the use of longer insulating tubes over the primary conductor, they may be used at higher voltages up to and including 6900 volts. For transformers for higher voltages, information will be furnished on application.

In sizes up to and including 1000 amperes, they have a capacity of 25 volt-amperes and are compensated for 12½ volt-amperes; above 1000 amperes they have a capacity of 50 volt-amperes and are compensated for 25 volt-amperes.

These "through-type" transformers have no primary windings, but slip over a cable, stud, or bus-bar, which forms the primary of the transformer. The type FS is intended for cables and round studs, and the type FB for rectangular bus-bars.

The momentary current due to a heavy short circuit on a large system is extremely great, and the mechanical stresses set up between the primary and secondary windings of a current transformer due to this current are very large. The "through-type" of transformer is the only type in which these stresses are balanced within the transformer itself; and this type is therefore of special value where, other types of transformers are liable to overstrain from such stresses.

NOTE—The 7500 and 10,000-ampere transformers are insulated for 500 volts. They are so constructed that they can be placed over a bus-bar in place, the two halves being joined by interleaving the laminations of the magnetic circuit and inserting the bolts.



TYPE FB 7500 AND 10,000-AMPERE PRIMARY

AMPERES		Capacity Volt-Amperes	Compensated for Volt-Amperes	Dimension Reference*	APPROX. WT., LBS.		Style No.	List Price
Primary	Secondary				Net	Boxed		
<b>Types FS for Cable or Stud</b>								
750	5	25	10	I	8	28	305241	\$27 00
1000	5	25	10	I	8	28	125055	29 00
1500	5	50	25	II	20	40	305242	36 00
2000	5	50	25	II	20	40	125059	40 00
2000	5	50	25	III	26	46	125060	40 00
2500	5	50	25	III	26	46	305243	44 00
3000	5	50	25	III	26	46	125062	50 00
<b>Type FB for Bus-Bars</b>								
750	5	25	10	IV	10	30	305244	27 00
1000	5	25	10	IV	10	30	125065	29 00
1500	5	50	25	V	20	40	305245	36 00
2000	5	50	25	V	20	40	125069	40 00
2000	5	50	25	VI	30	50	125070	40 00
2500	5	50	25	VI	30	50	305246	44 00
3000	5	50	25	VI	30	50	125072	50 00
4000	5	50	25	VII	44	69	219799	72 00
5000	5	50	25	VIII	58	83	219800	80 00
7500	5	50	25	X	46	71	305247	110 00
10000	5	50	25	X	56	81	241777	140 00

\*See table on next page.

Order by Style Number



CURRENT TRANSFORMERS—Continued

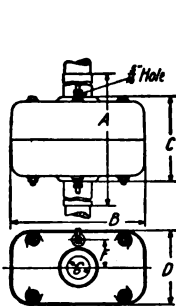


FIG. 1

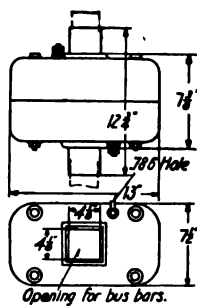


FIG. 3

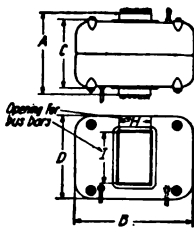


FIG. 4

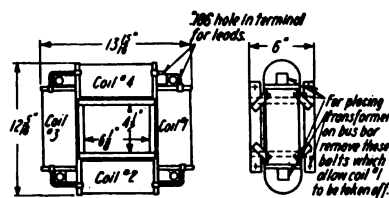


FIG. 5

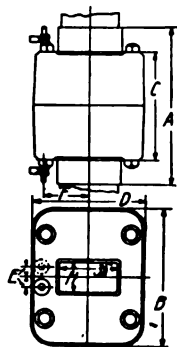


FIG. 2

Outline Dimensions\*

Dimension Reference	Fig.	DIMENSIONS, INCHES							FOR CABLE, STUD OR BUS-BARS	
		A	B	C	D	E	F	G Diam.	H	I
<b>Type FS for Cable or Stud</b>										
I	1	11 1/4	7 3/4	5 3/4	4 5/8	...	1 3/4	1 1/4	...	...
II	1	11 3/4	9 1/4	6 1/4	5 3/8	...	2	1 1/2	...	...
III	1	12 1/2	10 3/8	6 3/4	6	...	2 1/4	2 1/4	...	...
<b>Type FB for Bus-Bars</b>										
IV	2	10 3/4	6 3/4	5 3/4	5 3/4	1/4	2 1/4	...	1 1/4	...
V	2	11 1/4	8 1/4	5 3/4	5 3/4	1/4	2 3/4	...	1 1/2	...
VI	2	11 1/4	10 3/8	6	6 3/4	2 1/4	2 3/4	...	3 3/8	...
VII	3	...	...	...	...	...	...	...	...	...
VIII	4	12 1/4	10 3/4	7 3/4	9 3/4	...	...	...	2 3/4	6 3/4
X	5	...	...	...	...	...	...	...	...	...

TYPE KR (DRY TYPE) INDOOR

For Operating Relays and Circuit-Breaker Trip Coils  
Rated Voltage 6900

For 25 to 133-Cycle Circuits

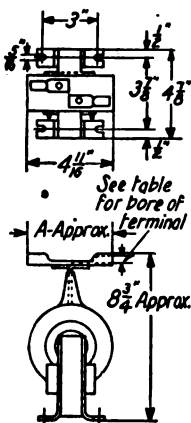
This line of transformers in capacities 5 to 200 amperes inclusive is supplementary, for circuit-breaker use, to the through-type FR transformers listed in capacities up to 500 amperes.

These transformers have sufficient capacity to operate relays or trip coils and will have an error in ratio not exceeding about 10% where the load at 4 amperes does not exceed 25 volt-amperes at 25 cycles or 65 volt-amperes at 60 cycles. They should not be used with relays where the circuit-breaker trip coil is in series with the relay.

These transformers are for use only with relays, or circuit - breaker trip coils. They have sufficient capacity for operating circuit-breakers within the limits of ordinary accuracy demanded in such service but should not be used for connection to measuring instruments. The general type of construction is similar to type KA transformers, except that these are much smaller.



TYPE KR



APPROX. DIMENSIONS\* OF TYPE KR

AMPERES	Primary	Secondary	Dimension A Inches	Bore of Terminals Inches*	APPROX. Wt.		Style No.	List Price
					Net	Boxed		
5	5	5	3 1/4	.186	9	29	187788	18 00
10	5	5	3 3/8	.186	9	29	187789	18 00
15	5	5	3 3/8	.186	9	29	187790	18 00
25	5	5	3 3/4	.259	9	29	187792	18 00
50	5	5	5 1/4	.384	9	29	187795	18 00
75	5	5	5 3/4	.384	9	29	242577	18 00
100	5	5	6 1/4	.558	10	30	187798	18 00
150	5	5	6 1/4	.558	10	30	242578	18 00
200	5	5	6 3/4	.558	10	30	187801	18 00

\*These dimensions are for reference only. For official dimensions apply to the nearest District Office.

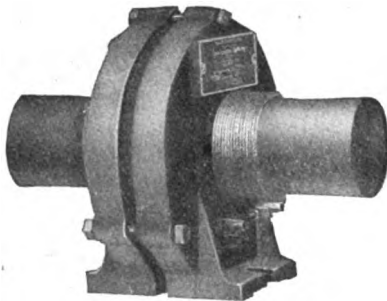
Order by Style Number

CURRENT TRANSFORMERS—Continued

THROUGH-TYPE FR (DRY TYPE) INDOOR

For Operating Relays and Circuit-Breaker Trip Coils

For 25 to 133-Cycle Circuits



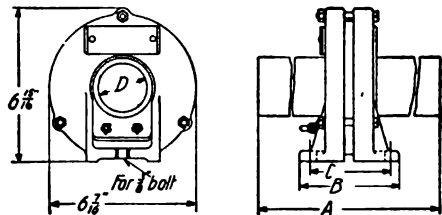
TYPE FR

service, these transformers may be so used where it is possible to calibrate the ammeter with the transformer. This application requires the use of a calibration curve for each instrument. The same transformers should not, however, be used both for instrument work and circuit-breaker work.

These transformers have sufficient capacity to operate relays or trip coils and will have an error in ratio not exceeding about 10 per cent where the load at 4 amperes does not exceed 25 volt-amperes at 25 cycles or 55 volt-amperes at 60 cycles. They should not be used with relays where the circuit-breaker trip coil is in series with the relay.

**Through-Type FR**—Similar to types FS and FB; but in the capacities covered by this line, 100 to 500 amperes inclusive, a through-type transformer cannot be made of sufficient accuracy for ordinary use in connection with measuring instruments. This line of transformers is, therefore, primarily adapted for circuit-breaker tripping, either through relays or by direct connection to the breaker.

In order to obtain the advantage of a through-type transformer of low current rating for ammeter



APPROX. DIMENSIONS† OF TYPE FR

AMPERES		DIMENSIONS, INCHES—			Holes for Cable	APPROX. WT., LBS.		Style No.	List Price
Primary	Secondary	A	B	C	Inches Diameter†	Net	Boxed		
<b>Rated Voltage 2300*</b>									
200	5	9 1/4	5 3/4	4 1/4	1 5/8	17 1/4	40	125076	\$21 00
300	5	8 1/2	5 1/4	3 1/4	2 1/4	12	32	125078	21 00
400	5	8 1/4	4 3/4	3 1/4	2 5/8	10	30	125079	21 00
500	5	8 3/4	4 3/4	3 3/4	2 3/4	9	29	125080	21 00
<b>Rated Voltage 6900*</b>									
200	5	15 1/4	5 3/4	4 1/4	1 5/8	17 1/4	40	125084	25 00
300	5	14 1/4	5 1/4	3 1/4	2 1/4	12	32	125086	25 00
400	5	14 1/4	4 3/4	3 1/4	2 5/8	10	30	125087	25 00
500	5	14 3/4	4 3/4	3 3/4	2 3/4	9	29	125088	25 00
<b>Rated Voltage 13,800*</b>									
100	5	24	8 3/4	7 1/4	1	23	43	125089	30 00
200	5	24	5 3/4	4 1/4	1 1/4	16 1/4	36	125092	30 00
300	5	24	5 1/4	3 1/4	1 1/4	12	32	125094	30 00
400	5	24	4 3/4	3 1/4	2	10	30	125095	30 00
500	5	24	4 3/4	3 3/4	2	9	29	125096	30 00

\*Transformers will operate satisfactorily at voltages up to 5 per cent above these values.

†These dimensions are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number

CURRENT TRANSFORMERS—Continued

TYPE OA (OIL INSULATED)

Rated Voltage 34,500. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes



TYPE OA INDOOR



TYPE OA OUTDOOR

These transformers are designed for separate mounting, in compartments or otherwise. They are heavily insulated between primary and secondary windings and form a barrier of great strength between the line and the instrument circuits.

**Double Secondary Type OA**—In cases where it is desirable to operate relays or circuit-breakers together with indicating instruments or watt-hour meters, transformers having two independent

secondary circuits can be furnished. The instruments can then be isolated from the relays or circuit-breakers, and the accuracy of the former will be unaffected by the heavy load represented by the latter.

**Outdoor Type OA** transformers differ from the indoor type only in having high-voltage outlet bushings suitable for outdoor service.

AMPERES		Bore of Terminals Inches	Gals. Oil*	INDOOR†		OUTDOOR	
Primary	Secondary			Style No.	List Price	Style No.	List Price
<b>Single Secondary</b>							
5-10	5	.384	12	217450	\$225 00	242360	\$275 00
10-20	5	.384	12	217451	225 00	242361	275 00
15-30	5	.384	12	217452	225 00	242362	275 00
25-50	5	.384	12	239609	225 00	242364	275 00
50-100	5	.558	12	239610	225 00	242367	275 00
75-150	5	.558	12	239611	225 00	242369	275 00
100-200	5	.745	12	217458	225 00	242371	275 00
150-300	5	.745	12	217463	225 00	242373	275 00
200-400	5	.918	12	217464	225 00	242374	275 00

**Double Secondary**

For double secondary add to list price of transformer..... \$75 00 \$90 00

Dimensions will be furnished on request.

**Approximate Weight**—Single secondary, indoor 275 pounds; outdoor, 295 pounds; add 60 pounds for boxing. Double secondary, indoor 475 pounds; outdoor, 495 pounds, add 80 pounds for boxing. Weights do not include oil; oil weighs approximately 7 pounds per gallon.

The current transformers have two primary windings which can be connected in series or parallel to give the lower or higher current rating listed.

\*Transformers are regularly shipped in their own tanks without oil—oil is shipped separately. On receipt at destination they should be filled with clean dry oil immediately.

†Indoor type shipped with high-voltage terminal in place.

Order by Style Number

CURRENT TRANSFORMERS—Continued

TYPE OB (OIL INSULATED)

Rated Voltage 44,000. Transformers will Operate Satisfactorily at Voltages up to 5 Per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes



INDOOR TYPE OB

These transformers are similar to the type OA transformer, but have a voltage rating of 44,000 volts.

**Double Secondary Type OB**—These are similar to the double secondary type OA, but have a voltage rating of 44,000 volts.

**Outdoor Type OB** transformers differ from the indoor type only in having outdoor type high voltage outlet bushings.

These transformers have two primary windings which can be connected in series or parallel to give the lower or higher current rating listed.

AMPERES		Bore of Terminals Inches	Gals. Oil*	INDOOR		OUTDOOR	
Primary	Secondary			Style No.	List Price	Style No.	List Price
<b>Single Secondary</b>							
5- 10	5	.384	56	217465	\$325 00	242385	\$400 00
10- 20	5	.384	56	217466	325 00	242386	400 00
15- 30	5	.384	56	217467	325 00	242387	400 00
25- 50	5	.384	56	239612	325 00	242389	400 00
50-100	5	.558	56	239613	325 00	242392	400 00
75-150	5	.558	56	239614	325 00	242394	400 00
100-200	5	.745	56	217473	325 00	242396	400 00
150-300	5	.745	56	217478	325 00	242398	400 00
200-400	5	.918	56	217479	325 00	242399	400 00

**Double Secondary**

For double secondary add to list price of transformer..... \$85 00 \$135 00

Dimensions will be furnished on request.

**Approximate Weight**—Single secondary, indoor, 850 pounds; outdoor, 525 pounds; add 150 pounds for boxing. Double secondary, indoor 700 pounds; outdoor, 770 pounds; add 175 pounds for boxing. Weights do not include oil; oil weighs approximately 7 pounds per gallon.

\*Transformers are regularly shipped in their own tanks without oil—oil is shipped separately. On receipt at destination they should be filled with clean dry oil immediately.

**TYPE A CURRENT BALANCING AUTO TRANSFORMERS**

Rated Voltage 115. For 25 to 133-Cycle Circuits

These auto transformers are mounted in cast iron end caps with leads extending downward. They have a large number of taps so arranged that their ratio can be varied upward and downward by small steps.

In the differential protection of large transformers, small differences in the ratio of the cur-

rent transformers or a change in the main transformer taps may cause an unbalance of the currents in the differential circuit. Such an unbalance may cause false tripping of the relay. The current balancing auto is used to effect an exact ratio balance between the currents in the two circuits of the differential system.

Nominal Ratio	APPROXIMATE WEIGHT, POUNDS		Style No.	List Price
	Net	Boxed		
5 to 5 Amperes	16	26	356198	\$22 00
8.66 to 5 Amperes	16	26	356199	22 00

CURRENT TRANSFORMERS—Continued

TYPE OC (OIL INSULATED)

Rated Voltage 66,000. Transformers will Operate Satisfactorily at Voltages up to 5 per Cent Above this Value

For 25 to 133-Cycle Circuits

Capacity 50 Volt-Amperes, Compensated for 25 Volt-Amperes

These transformers are similar to the type OA transformers, but have a voltage rating of 66,000 volts.

**Double Secondary Type OC**—Similar to the double secondary type OA, but have a voltage rating of 66,000 volts.

**Outdoor Type OC** transformers differ from the indoor type only in having outdoor type high voltage outlet bushings.

These transformers have two primary windings which can be connected in series or parallel to give the lower or higher current rating listed.



TYPE OC INDOOR



TYPE OC OUTDOOR

AMPERES Primary	Secondary	Bore of Terminals Inches	Gals. Oil*	INDOOR		OUTDOOR	
				Style No.	List Price	Style No.	List Price
<b>Single Secondary</b>							
5-10	5	.384	60	217880	\$460 00	242400	\$660 00
10-20	5	.384	60	217881	460 00	242401	660 00
15-30	5	.384	60	217882	460 00	242402	660 00
25-50	5	.384	60	239815	460 00	242404	660 00
50-100	5	.558	60	239816	460 00	242407	660 00
75-150	5	.558	60	239817	460 00	242409	660 00
100-200	5	.745	60	217886	460 00	242411	660 00
150-300	5	.745	60	217893	460 00	242413	660 00
200-400	5	.915	60	217894	460 00	242414	660 00

**Double Secondary**

For double secondary, add to list price of transformer.....\$150 00 \$200 00

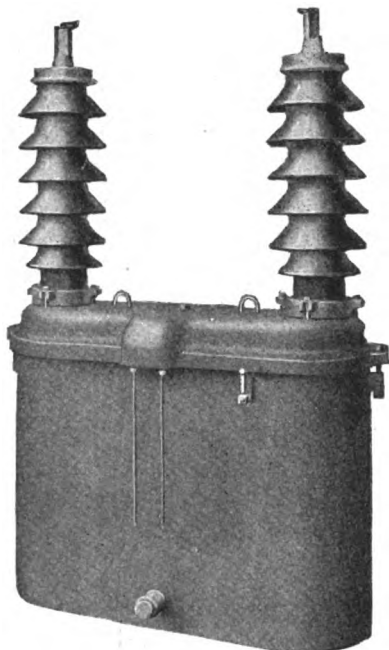
Dimensions and Weights will be furnished on request.

Approximate Weight—Single secondary, indoor 575 pounds; outdoor, 700 pounds; add 175 pounds for boxing. Double secondary, indoor 900 pounds; outdoor 1025 pounds; add 200 pounds for boxing. Weights do not include oil; oil weighs approximately 7 pounds per gallon.

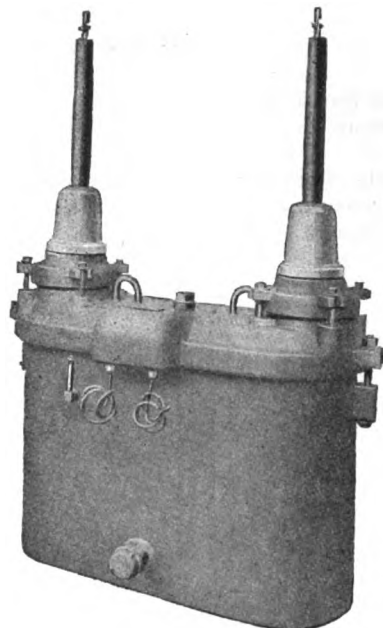
\*Transformers are regularly shipped in their own tanks without oil—oil is shipped separately. On receipt at destination they should be filled with clean, dry oil immediately.

Order by Style Number

## VOLTAGE TRANSFORMERS



66,000-VOLT OUTDOOR  
OIL-INSULATED



23,000-VOLT INDOOR  
OIL-INSULATED

**Dry-Type**—The dry-type voltage transformers are mounted in end frames and are adapted for use on voltages up to 6900. Fuse blocks may be mounted on these end frames, when desired, for the 2300 volt class and for lower voltages.

**Oil-Insulated Type**—The oil-insulated type voltage transformers are designed for use on voltages from 2300 to 66,000. Up to 6900 volts they are mounted in cases made to fit in cells or in the limited space behind switchboards and the transformers are so designed that the high-voltage leads can be brought through either the top or the sides of the case, by means of the extra bushing holes and flanges. This feature is of particular advantage in switchboard wiring.

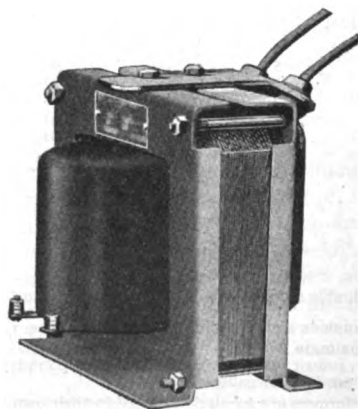
**Outdoor Type**—Oil insulated transformers for outdoor operation can be furnished for standard voltages—prices for outdoor transformers of voltages lower than those listed will be supplied on request.

**Semi-Portable Type**—In the ordinary form of portable voltage transformers, extreme accuracy is sacrificed to obtain portability and convenience of application. The semi-portable transformer is the standard dry-type transformer fitted with a special carrying handle and terminals as shown.

The ratio of transformation should be such as to give a nominal voltage of 115 on the instruments.

Thus, for a 2300-volt circuit, a 20:1 ratio should be used, making the normal voltage on the instruments 115. Transformers for any special ratio or voltage not listed herein can be supplied, but it is recommended that standard transformers be ordered whenever possible.

**Choke Coils**—For protection against line surges transformers designed for voltages of 34,500 and above, have choke coils mounted in their cases and connected between the transformer windings and the line.



DRY-TYPE

VOLTAGE TRANSFORMERS—Continued

**Fuse Protection**—The style number and list price of voltage transformers do not include fuse blocks.

Front-connected fuse blocks made of glazed porcelain are available. They are adapted to the protection of instrument transformers up to 2300 volts. The base can be bolted to the fuse block

supports on standard Westinghouse dry-type voltage transformers, thus economizing space and making a compact equipment. For description, dimensions, ratings, and prices of instrument-transformer fuse blocks, see catalogue on "Westinghouse Miscellaneous Switches and Carbon Circuit-Breakers."

Capacity, 200† Volt-Amperes

Compensated For 40 Volt-Amperes

Nominal Secondary Voltage, 115<sup>o</sup>

TYPE VS

WITHOUT OIL—INDOOR

Rated Primary Voltage	Voltage Ratio	25 Cycles			60 Cycles			
		APPROX. Wt.* LBS.		Style No.	APPROX. Wt.* LBS.		List Price	
		Net	Boxed		Net	Boxed		Style No.
230	2:1	36	61	303917	20	45	303911	\$24 00
460	4:1	36	61	303918	21	46	303912	26 00
575	5:1	36	61	303919	21	46	303913	28 00
2300	20:1	66	91	369818	25	50	303914	30 00
4600	40:1	80	105	303921	45	70	303915	46 00
6900	60:1	95	120	303922	50	75	303916	60 00

WITHOUT OIL—SEMI-PORTABLE

Rated Primary Voltage	Voltage Ratio	APPROX. Wt.* LBS.	Style No.	List Price	APPROX. Wt.* LBS.	Style No.	List Price	
		Net	Boxed		Net	Boxed		
230	2:1	39	69	303899	33	63	303895	31 00
460	4:1	41	71	303900	33	63	303896	33 00
575	5:1	48	78	303901	39	69	303897	35 00
2300	20:1	50	80	303902	39	69	303898	37 00

GUM-FILLED—OUTDOOR

Rated Primary Voltage	Voltage Ratio	APPROX. Wt.* LBS.	Style No.	List Price	APPROX. Wt.* LBS.	Style No.	List Price	
		Net	Boxed		Net	Boxed		
2300	20:1	102	130	370005	39	49	370002	\$50 00
4600	40:1	140	185	370006	81	103	370003	60 00
6900	60:1	147	192	370007	83	105	370004	125 00

OIL—INSULATED—INDOOR

Rated Primary Voltage	Voltage Ratio	25 Cycles			60 Cycles						
		APPROX. Wt.* LBS.		Style No.	APPROX. Wt.* LBS.		List Price				
		Net	Boxed		Gal. Oil	Net		Boxed	Gal. Oil	Style No.	
2300	20:1	117	160	2 3/4	303906	\$55 00	86	111	2 3/4	303903	45 00
4600	40:1	148	190	4	303907	65 00	103	138	4	303904	55 00
6900	60:1	162	210	4	303908	90 00	110	145	4	303905	80 00

TYPE VC

OIL-INSULATED—INDOOR

Rated Primary Voltage	Voltage Ratio	APPROX. Wt.* LBS.	Style No.	List Price	APPROX. Wt.* LBS.	Style No.	List Price				
		Net	Boxed		Net	Boxed					
11500	100:1	210	250	4 1/2	303910	135 00	160	200	5	303909	110 00
13800	120:1	220	265	6	303924	140 00	170	210	6	303923	115 00
23000	200:1	485	665	20	271871	375 00	450	640	19	271867	375 00
34500	300:1	750	1000	36	271872	500 00	460	650	23	271868	500 00
44000	400:1	900	1150	42	271873	700 00	750	1000	42	271869	700 00
66000	600:1	1500	1675	85	271874	1000 00	1100	1470	85	271870	1000 00

OIL-INSULATED—OUTDOOR

Rated Primary Voltage	Voltage Ratio	APPROX. Wt.* LBS.	Style No.	List Price	APPROX. Wt.* LBS.	Style No.	List Price				
		Net	Boxed		Net	Boxed					
11500	100:1	205	265	6	369195	160 00	173	223	5 1/2	369194	145 00
13800	120:1	205	265	6	369196	175 00	173	223	5 1/2	332242	160 00
23000	200:1	535	715	20	271879	400 00	500	690	19	271875	400 00
34500	300:1	700	950	36	271880	600 00	510	700	23	271876	600 00
44000	400:1	975	1225	42	271881	850 00	825	1075	42	271877	850 00
66000	600:1	1400	1770	85	271882	1200 00	1200	1570	85	271878	1200 00

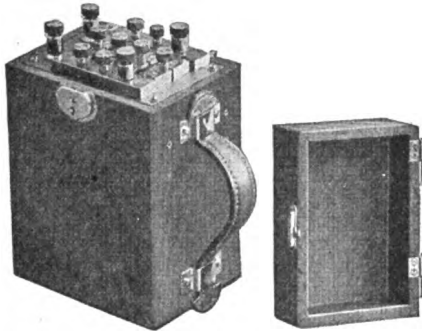
\*Weights given do not include oil. Weight of oil per gallon is approximately 7 pounds net and 9 pounds gross.

†For 500-volt-ampere dry-type voltage transformers see "Accessories" for "Generator Voltage Regulators."

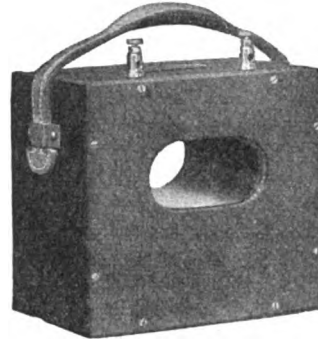
‡Normal secondary voltage for 44000 and 66000 voltage transformers is 110 volts.

Order by Style Number

## PORTABLE CURRENT TRANSFORMERS



PLUG-TYPE PORTABLE CURRENT TRANSFORMER



THROUGH-TYPE PORTABLE CURRENT TRANSFORMER, STYLE NO. 37281

**Accuracy**—Portable current transformers are generally used for emergency tests in the field and are therefore made smaller in size and lighter in weight than the switchboard instrument transformers in order to facilitate their portability. It is therefore necessary to work the material in these at a somewhat higher density than in the case of switchboard transformers, so that the error in ratio will be somewhat greater than for switchboard-type transformers.

**Capacity**—These current transformers are rated at a current which gives 5 amperes secondary. Since 5 amperes represents the full scale rating of most instruments, the transformers are usually applied to a circuit whose full-load rating is about 65 per cent of the rating of the transformer. They therefore should not be used for continuous operation on a load greater than 65 per cent of their rated primary current, and for not more than two hours at full primary capacity, but can be used for short periods on loads of 150 per cent rated primary current.

**Secondary Capacity**—All the portable current transformers listed are compensated for  $12\frac{1}{2}$  volt-amperes load at five amperes secondary. Except where noted to the contrary, they are for use on either 25 or 60-cycle circuits.

### Plug-Type

**Construction**—The coils of the primary can be connected either in series, in series-parallel, or in parallel, by means of connecting plugs to obtain a suitable ratio.

These transformers are contained in a neat wooden case with a cover and handle for carrying.

**Insulation**—The plug-type transformers are insulated for use on 2300-volt circuits.

**Accuracy**—The ratio accuracy of the plug-type transformers is guaranteed to be within one per cent at the full-current rating with each ratio setting

when used with a load of  $12\frac{1}{2}$  volt-amperes on the secondary.

### Through-Type

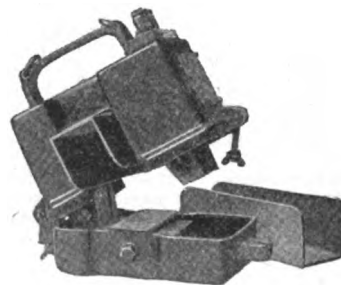
**Construction**—The through-type transformer is constructed so that the conductor of the circuit to be measured forms the primary winding. The conductor is passed through the hole in the case once for the highest rating, twice for the middle rating, and four times for the low rating. It is mounted in a wooden case with handle for carrying.

**Insulation**—Style No. 29796 is insulated for 2300-volt circuits and Style No. 37281 for 575 volts. It is assumed that for higher voltages they will be used over cable having sufficient insulation for protection of operator and instrument.

**Accuracy**—The ratio accuracy of the through-type transformers is guaranteed to be within one per cent at the full current rating with each ratio setting when used with a load of  $12\frac{1}{2}$  volt-amperes on the secondary.

### Split-Type

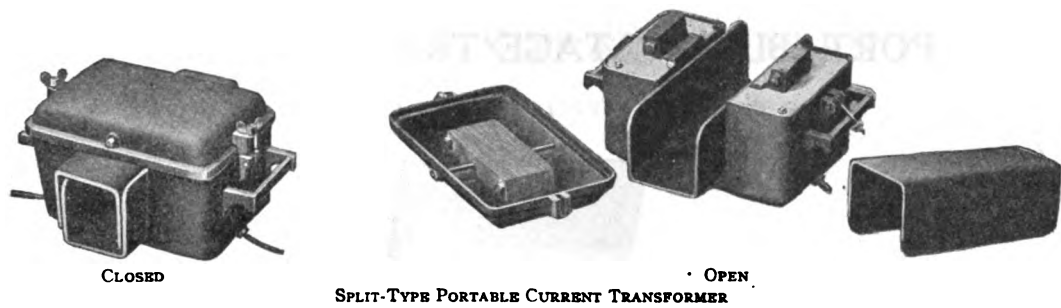
**Application**—These transformers are used for making measurements of current in circuits that it would be inconvenient or impossible to open, in stations or on large systems. Except Style No.



SPLIT-TYPE TRANSFORMER  
Style No. 117508, for use with type PR ammeter



PORTABLE CURRENT TRANSFORMERS—Continued



117508 they may be used without special calibration with any standard ammeters having 5-ampere coils.

**Construction**—The iron core of the split-type transformer is built in the shape of a rectangle with an opening through its center, the opening varying in size according to the capacity of the transformer. One side of the core is detachable so that the other part of the core can be slipped over the conductor and the detached side then clamped tightly in place.

Each transformer is suitable for only one primary current, but can be used for one-half or one-quarter normal current by passing the conductor two or four times through the opening. It is mounted in a metal case with metal handle cast on case.

**Insulation**—The split-type current transformers are insulated for use on 6900-volt circuits, it being assumed that for higher voltages they will be used over cable having sufficient insulation for the protection of the operator and instrument.

**Accuracy**—The ratio accuracy of the split-type transformer is guaranteed to be within two per cent

at the full current rating when used with a load of 12½ volt-amperes on the secondary.

In a split-type transformer the phase displacement is high, due to the fact that the magnetic circuit is broken by two small air gaps. It is also a variable quantity as the contact will vary every time the transformer is opened and closed. The effect of phase displacement is to make a watt-hour meter or wattmeter read high, especially at low line power factor. This error varies roughly from ½ to 1½ per cent at 90 per cent line power factor to 3 to 8 per cent at 50 per cent line power factor. For this reason the split-type current transformer is not suitable for use with wattmeters or watt-hour meters.

**Type PR Portable Testing Outfit**—A testing outfit consisting of split-type transformers, Style No. 117508, type PR ammeter, and leads is described on the pages on type PR ammeters.

Style number and list price include transformer complete as described.

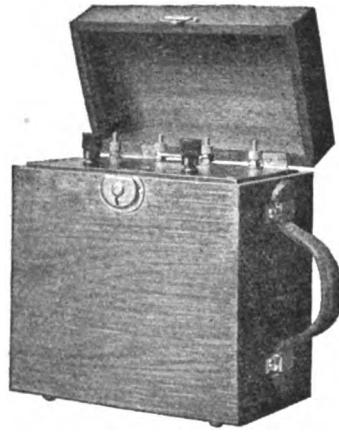
Primary Amperes at 5 Amp. Secondary	DIMENSIONS—INCHES			APPROXIMATE WT., LBS.		Style No.	List Price
	Approx. Overall	Opening for Primary Conductor	Net	Shipping			
<b>Plug-Type</b>							
10, 20 or 40	6¼x9 x4¼	.....	15	35	29795	865 00	
25, 50 or 100	6 x8½x 4¼	.....	15	35	35591	65 00	
<b>Through-Type</b>							
100, 200 or 400	7 x7 x4½	2 (dia.)	15	35	29796	50 00	
400, 800 or 1600	8½x7½x5	2 x4	20	40	37281	55 00	
<b>Split-Type</b>							
500 } 750 } 1000 } 1500 }	11½x10x7½	1¾x3¾	35	50	{ 305248 305249 108145 305250	60 00	
						62 00	
						64 00	
						66 00	
1000 } 1500 } 2000 }	12¾x10½x7	2½x3¾	40	65	{ 305251 305252 108149	66 00	
						68 00	
						72 00	
2000 } 2500 } 3000 }	11x12¾x6¾	3½x3¾	45	70	{ 108150 305253 108152	72 00	
						76 00	
						80 00	

Split-Type For Testing Set

Frequency Cycles	Full Scale Capacity Amperes	Description	Opening in Transformer for Conductor Inches	APPROXIMATE WT., LBS.		Style No.	List Price
				Net	Shipping		
60	125 or 250	Transformer only	1¾x1¼	19¼	35	117508	865 00

Order by Style Number

## PORTABLE VOLTAGE TRANSFORMERS



**Construction**—These voltage transformers are of the improved core type mounted in wood cases with a leather handle. They have insulated binding posts for the secondary connections and uninsulated binding posts for the primary. The primary binding posts are left uninsulated because it is impossible to insulate them sufficiently for perfect safety under all conditions, and a partly insulated terminal is considered to be more dangerous than a bare one.

**Insulation**—For 575 and 2300-volt transformers the primary winding will stand a test of 10,000 volts. For 460-volt transformers the primary winding will stand a test of 5000 volts. The secondary winding in all cases is tested at 2000 volts.

**Accuracy**—The ratio accuracy of these transformers is guaranteed to be within  $\frac{1}{2}$  per cent of the full voltage rating when used with a load of 20 volt-amperes on the secondary. They will carry a load of 100 volt-amperes continuously.

**Secondary Capacity**—All portable voltage transformers listed are compensated for 20 volt-amperes at 115 volts secondary. Without appreciable change in accuracy, the 25-cycle transformers may be used on 60 cycles and the 60-cycle transformers on 133 cycles.

**Style number and list price** include transformer complete as described.

Primary Volts at 115 Volts Secondary	Approx. Overall Dimensions Inches	APPROX. WT., LBS.		Style No.	List Price
		Net	Shipping		
<b>For 25-Cycle Circuits</b>					
460- 230 575- 287 $\frac{1}{2}$ 2300-1150	10x5 $\frac{1}{4}$ x10 $\frac{1}{4}$	27	48	{ 215976 370009 190797	{ \$60 00 85 00 70 00
<b>For 60-Cycle Circuits</b>					
460- 230 575- 287 $\frac{1}{4}$ 2300-1150	9 $\frac{1}{4}$ x5 $\frac{1}{4}$ x8 $\frac{1}{4}$	18 $\frac{1}{2}$	33	{ 215978 370008 190798	{ 55 00 80 00 85 00

*Order by Style Number*

# DISTRIBUTION TRANSFORMERS

## POLE, PLATFORM, OR MANHOLE MOUNTING

### SINGLE OR THREE-PHASE

60 or 25 Cycles

Distribution transformers range in capacity from 1 to 200 kilovolt-amperes and are listed for voltages from 460 to 46,000 volts, both 25 and 60 cycles. As no one form of construction is best adapted for this wide range of capacity and voltage, Westinghouse distribution transformers are made in four different forms of construction. The particular construction used is determined by consideration from all standpoints as to which design is best suited for the particular voltage, capacity and frequency.



FIG. 1—GROUP OF STEEL-CLAD TYPE S TRANSFORMERS

FORM OF CONSTRUCTION	GENERAL APPLICATION
Distributed Shell	Single-Phase Transformers for 460, 575, 2300 and 4600-volt distribution service.
Rectangular-Core	Single-Phase Transformers for distribution service from 4600 to 23,000 volts. Three-Phase Transformers for distribution service from 460 to 23,000 volts.
Cruciform-Core	Single and Three-Phase Transformers for 34,500 to 46,000-volt distribution service.
Simple-Shell	Large capacity 25-cycle transformers for distribution service from 2300 to 13,800 volts.

Distribution transformers are required for pole, platform, or manhole mounting, single or three phase, and to distinguish not only the form of construction but also the class of service, Westinghouse distribution transformers are listed under eleven different types, as follows:

TYPE	CLASS OF SERVICE	FORM OF CONSTRUCTION
S	Single-Phase, Pole or Platform-Mounting	Distributed-Shell
SA	Single-Phase, Pole or Platform-Mounting	Distributed-Shell
SM	Single-Phase, Manhole-Mounting	Distributed-Shell
SK	Single-Phase, Pole or Platform-Mounting	Rectangular-Core
SKA	Single-Phase, Pole or Platform-Mounting	Rectangular-Core
SKM	Single-Phase, Manhole-Mounting	Rectangular-Core
ST	Three-Phase, Pole or Platform-Mounting	Rectangular-Core
STM	Three-Phase, Manhole-Mounting	Rectangular-Core
SC	Single-Phase, Platform-Mounting	Cruciform-Core
SCT	Three-Phase, Platform-Mounting	Cruciform-Core
SS	Single-Phase, Platform-Mounting	Simple-Shell

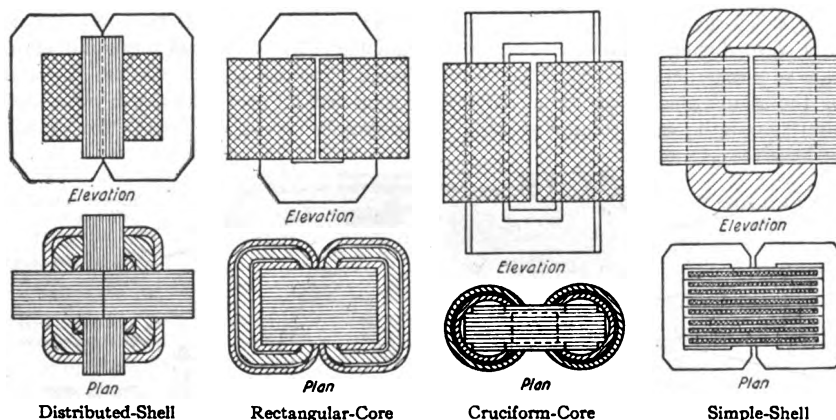


FIG. 2—DIAGRAMS OF ARRANGEMENTS OF COILS AND MAGNETIC CIRCUITS OF WESTINGHOUSE DISTRIBUTION TRANSFORMERS

(In these diagrams, the coils are indicated by oblique or crossed oblique lines; and the iron by horizontal or vertical lines or by unshaded portions.)

## DISTRIBUTION TRANSFORMERS—Continued

## CONSTRUCTION

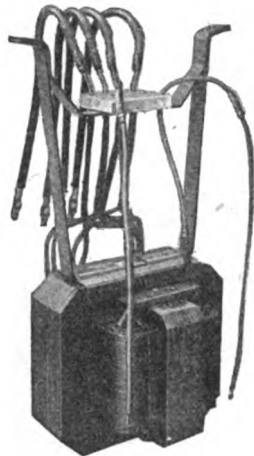


FIG. 3—COILS AND IRON OF DISTRIBUTED-SHELL, STEEL-CLAD, TYPE S TRANSFORMER

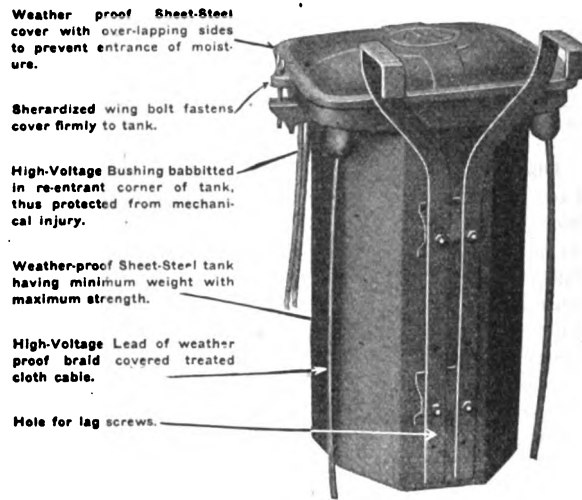


FIG. 4—STEEL-CLAD TYPE S TRANSFORMER (Showing Two-Piece Hanger Irons Bolted On, Ready for Hoisting to Crossarm)

### DISTRIBUTED-SHELL TYPES S, SA AND SM

**General**—The distributed-shell form of construction consists of concentric rectangular coils with a four-part magnetic circuit.

The laminations are clamped top and bottom with sheet-metal end-frames, which are held together by locking irons and which remove all strain from the coils. The transformer is centered by a projection in the bottom of the tank and is locked in position by means of wrought iron braces welded to the upper end-frame and bolted to the sides at the top of the tank. In this way positive assurance is provided that the transformer will be held securely in position in the case during shipment. The tanks and covers are of sheet-metal pressed to shape and welded along the seams, this construction combining maximum strength with minimum weight.

The sheet-metal tanks are rendered thoroughly weatherproof by the application of a coat of special paint to the tank surfaces immediately after they have been sand-blasted. The sand blasting removes all scale and dirt and gives a roughened surface which provides an excellent mat for the adhesion of the weatherproof coating. The primary coating of paint is dried in an oven specially designed for this purpose. This is continued for several hours until the coating has hardened and become integral with the roughened tank surface. A finishing coat of a heavy oil paint is next applied and baked on, giving the case a smooth and pleasing finish which is impervious to the action of the weather.

The distributed-shell type of construction, (rectangular coils with two large and two small magnetic circuits—see Fig. 2), has a relatively small mean turn of iron and copper, which results, at the voltage and capacity for which it is used, in a

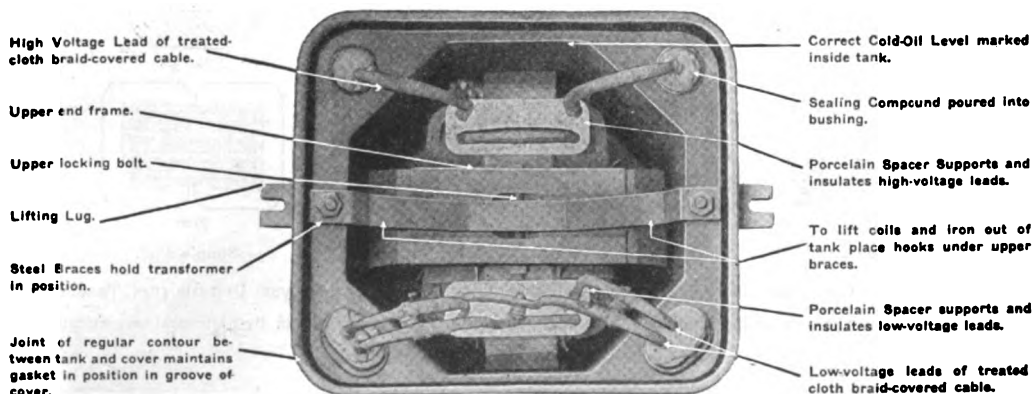


FIG. 5—TOP VIEW (COVER REMOVED) OF SMALL-CAPACITY, STEEL-CLAD, TYPE S TRANSFORMER (All Parts Accessible for Inspection)

## DISTRIBUTION TRANSFORMERS—Continued

well-balanced electrical performance (high efficiency, good regulation and low exciting current) for a given weight of material.

**Insulation**—An exclusive feature of Westinghouse distribution transformers is the use of machine-moulded mica-micarta barriers between windings. The barriers are continuous and uniform in mechanical and electrical strength, and contain several layers of built-up sheet mica. The dielectric strength of these barriers is shown by the fact that the tubes used for 2300-volt transformers have an ultimate breakdown strength when tested under oil of around 70,000 volts although they are only approximately  $\frac{1}{8}$  inches in thickness. Channel pieces of mica on the smaller sizes and micarta or fullerboard collars of insulation on the larger sizes are placed along the ends of the high voltage coils. This insulation provides protection from abnormal voltage stresses between the coils and the magnetic circuit caused by high-frequency line-surges.

Standard steel-clad type S transformers are not supplied with terminal blocks, but instead por-

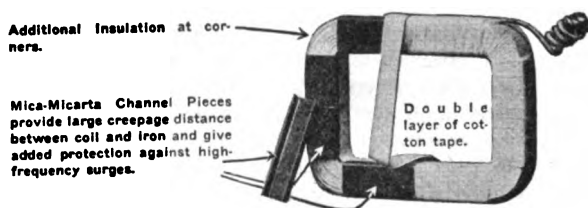


FIG. 6—MACHINE-WOUND HIGH-VOLTAGE COIL OF DISTRIBUTED-SHELL (TYPE S) TRANSFORMERS

(Partially Complete, Showing Micarta Channel Pieces)

celain spacers, mounted on the wrought-iron straps or on the end-frames are provided to insulate and support the leads between the coils and the porcelain bushings. Wherever it is necessary to furnish a terminal block, such as in the case of a transformer with high-voltage taps, the terminal block is submerged below the level of the oil to prevent flash-overs, due to lightning surges, from the terminal studs to the case. The bushings used with the steel-clad type S transformers are large and have a long flash-over distance. This feature is particularly desirable on account of the increasing use of the 2300-4000-volt, 3-phase, 4-wire system with resultant greater strain from this service on the 2300-volt transformer bushings.

**Coil Construction**—All coils are wound separately on moulds or micarta tubes. This permits

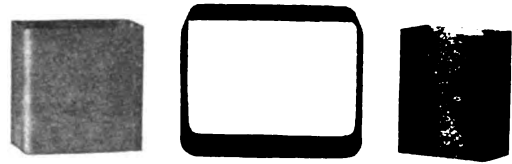


FIG. 7—MACHINE-MOULDED MICA-MICARTA BARRIERS

careful inspection and testing at all stages of manufacture and assures uniformity and reliability. The high-voltage coils are sub-divided into sections to reduce the voltage stress between layers. In certain sizes, from 5 to 10 kv-a, inclusive, special machine-wound high-voltage coils of round wire are used. These are so wound that each wire lies in a gutter formed by two other wires of the preceding layer. This construction makes a very strong coil mechanically, prevents crawling of the wires and gives an excellent space factor. For larger capacities, copper strap is used for the high voltage coils. The low-voltage coils are of round wire or copper strap, wound directly on micarta barriers.

**Magnetic Circuit**—The four-part magnetic circuit is built up with L-shaped punchings of non-aging silicon steel. This steel is manufactured under rigid Westinghouse specifications, but the steel from different heats is necessarily subject to slight variations in quality. To assure uniform magnetic characteristics, the sheets are graded after annealing and the highest grade only is selected for use in the manufacture of Westinghouse distribution transformers. The effect of punching out the sheets is to increase the hysteresis loss and this effect is removed by re-annealing the punchings.

It is a well-known fact that much vigilance is necessary to assure uniformity of iron loss and exciting current. In Westinghouse distribution transformers the special arrangement of the magnetic circuit, which has a minimum mean length of turn, combines with careful selection of the steel, double annealing, enameling and weighing, to produce a uniformly low iron loss. A small exciting current

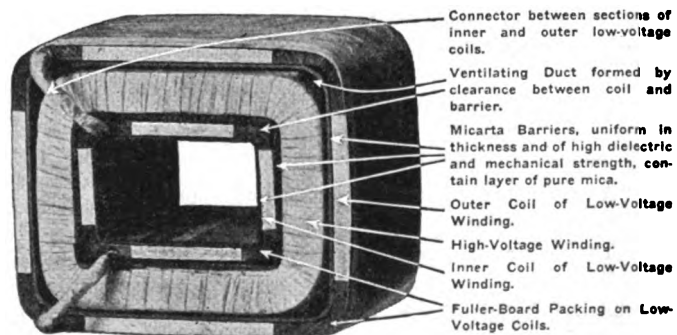


FIG. 8—COIL GROUP OF SMALL DISTRIBUTED-SHELL (TYPE S) TRANSFORMER (All Coils Wound Separately on Moulds or on Micarta Barriers)

## DISTRIBUTION TRANSFORMERS—Continued

is secured by working the iron at low inductions, by care in building and by the use of "L"-shaped punchings, so assembled that the reluctance of the magnetic circuit differs only slightly from that of a circuit without joints.

**Assembly**—The high and low-voltage windings are first assembled with micarta insulating barriers and then an exact weight of "L"-shaped punchings is built-up around the coils, piece by piece, the coils being protected against abrasion by fullerboard saddles. This method prevents mechanical injury to the windings and provides additional insulation between the coils and the iron. The top and bottom end-frames are next clamped on to the magnetic circuit by bolts which pass through locking irons which fasten the upper and lower end frames together. The complete transformer is then subjected to an impregnation treatment.

**Impregnation**—Type S transformers are impregnated with the coils and iron assembled complete. The assembled units are first placed in an oven through which a current of heated air is circulated. After this preliminary drying-out process the transformers are lowered into a vacuum tank. The cover of this tank is bolted on and after a preliminary heating in the tank a vacuum is established. All air and the remaining moisture, which evaporates readily at the low pressure, are removed. The impregnating compound, which consists of a mixture of resinous gums and which has been pre-heated in an adjoining tank, is then drawn into the vacuum tank until it completely covers the transformers. The air and moisture having previously been removed, the compound is drawn by capillary attraction into all the interstices of the winding, but to assure the most thorough coil penetration, a gas pressure of over 80 pounds per square inch is applied which forces the compound into the winding. After a period of several hours the remainder of the compound is withdrawn from the vacuum tank and the transformers are lifted out and placed in a vertical position to cool.

The treatment has the following advantages:

- (1) The insulation strength of the windings is greatly improved, the function of the cotton covering of the wires and other fibrous insulations being simply to act as spacers which have a high dielectric strength after absorbing the insulating compound.
- (2) The heat conductivity of the windings is increased which eliminates hot spots and produces a more uniform temperature rise.
- (3) After impregnation the windings will not readily absorb moisture.
- (4) The mechanical strength of the windings is increased.

**Mechanical Details**—Type S transformers present a neat and well-finished appearance. The mechanical details have been designed to secure convenience for inspection, storage and instal-

lation. The case is light but strong, which facilitates handling. Simple two-piece hanger irons and lugs on the sides of the tanks are provided for lifting and mounting the transformers. Sherardized wing-bolts and nuts fasten the cover to the tank and are so arranged that the cover can be removed without unscrewing the nuts from the wing bolts. The bushings are babbitted into the re-entrant corners or the overhanging sides of the tank, and are thus protected against mechanical injury. Pressed-tube copper connectors are supplied on the low-voltage leads. The quantity of oil is specified on the nameplate and the cold-oil level is marked inside the case. The connection diagram is fastened inside the cover and the per cent impedance is given on the nameplate so that the possibility of group or parallel operation with other transformers can be readily determined. Oil siphoning is prevented by placing a solid joint in each lead above the oil level. A felt gasket protected by an over-hanging cover prevents the entrance of moisture and the smooth contour of the joint between the cover and tank which has curves of large radius prevents the displacement of the gasket when the cover is removed.

**Application**—Types S and SA transformers are both arranged for pole or platform mounting and have their general field of application in 2300-volt distribution service. The difference between the two types is that type SA transformers have a lower efficiency, smaller size of parts, and consequently a lower price than type S transformers of the same rating. It should be understood that the type SA transformer differs in operating characteristics from the type S only on the question of electrical performance, and that in quality of material, grade of workmanship and insulation strength the type SA transformer is in every respect the equal of the type S. Type SA transformers find their correct application on circuits which have a high load factor and they can also be used to advantage where the cost of generating power is relatively small, such as in the case of a water-power plant. For such service the saving in initial investment will usually more than counterbalance the losses resulting from the lower efficiency.

Type SM transformers are type S transformers arranged for manhole service.

Manhole transformers operate in vaults and therefore are provided with water-proof tanks. The smallest sizes of type SM transformers are mounted in cast-iron tanks and the larger sizes in corrugated sheet-iron tanks with top flange and base cast on. The joint between the cover and the tank is made perfectly water-tight and air-tight by a special gasket. Sherardized bolts and nuts that are rust-resisting are used to clamp the cover to the tank. Rusting of the tanks is effectually prevented, as the cast-iron tanks are coated with a weatherproof finish

## DISTRIBUTION TRANSFORMERS—Continued



FIG. 9—TYPE SM MANHOLE TRANSFORMER IN MACHINE MOULDED CAST-IRON TANK

and the sheet-iron tanks are first coated with a special grade of weatherproof paint and then are finished with a coating of heavy oil paint.

Since these transformers are made perfectly airtight, internal pressures are developed due to the expansion of the air and oil caused by the increase in temperature on load. An air chamber between the oil level and the cover forms a cushion for this expansion.

The leads from the low-voltage winding are connected to a terminal block inside the tank and the

different low-voltage connections are made on this block. The leads from the high-voltage winding are connected to a terminal block below the oil level.

To connect the transformer to the line, the cover is first removed; the lead-covered cables are drawn through the outlet bushings; and connectors, which have been soldered to the ends of the cable, are attached to the studs on the terminal blocks.

The outlet bushings for these transformers are standard pipe unions. One-half of the union is welded to a short brass pipe which in turn is screwed into the top casting of the transformer. The other half of the union is welded to a short piece of brass pipe which forms a nipple to which, on installation, the lead covering of the cable is attached by a plumber's wiped joint.

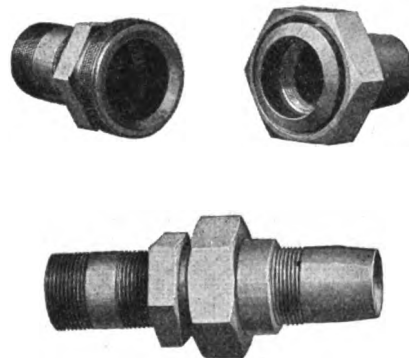


FIG. 11—UNION-TYPE BUSHING USED ON MANHOLE TRANSFORMERS

To disconnect the transformer from the line, the line leads are disconnected from the terminal blocks, the pipe unions are disconnected, and the lead cables withdrawn.

### RECTANGULAR-CORE—TYPES SK, SKA, SKM, ST AND STM

**General**—The rectangular-core form of construction has a core of rectangular cross-section, with rectangular sets of concentric coils. The punchings are clamped top and bottom with end-frames which remove all strain from the coils. The top and bottom end-frames are held together by locking irons. The transformer is held in position by supports which are attached to the top flange of the tank and thus hold the transformer in position. The tanks are of cast iron in the smaller sizes; the larger sizes have corrugated sheet iron walls welded by the oxy-acetylene process with base and top-flange cast-on.

The combination of rectangular coils with a core of rectangular cross-section composed of L-shaped

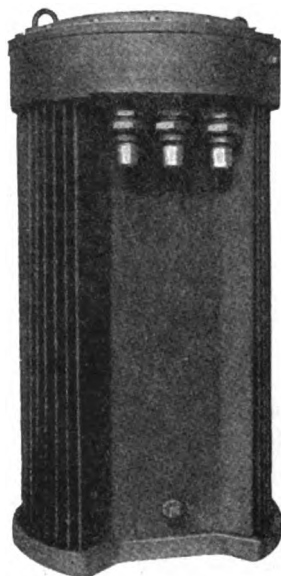


FIG. 10—TYPE SM MANHOLE TRANSFORMER IN TANK OF CORRUGATED SHEET-IRON SIDES WITH BASE AND TOP-FLANGE CAST ON

## DISTRIBUTION TRANSFORMERS—Continued

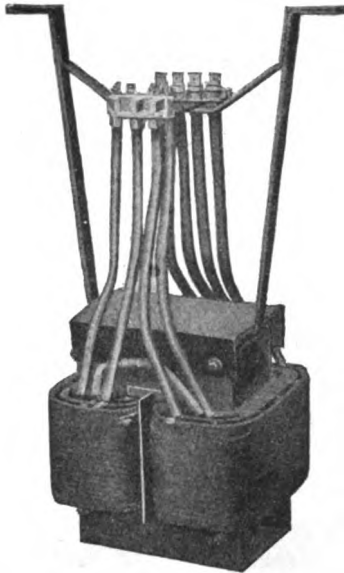


FIG. 12—COILS AND IRON OF LARGE-CAPACITY RECTANGULAR-CORE (TYPE SK) TRANSFORMERS

punchings gives better results for the higher voltage classes than the shell type of construction. This form of construction, in its own field of service, gives the highest electrical performance for a given weight of material.

**Insulation**—Bakelized micarta tubes are used between windings. The end turns of the high-voltage windings are strongly reinforced against high-frequency surges and built up insulation at the ends of the coils provides additional creepage distance between the coils and the iron circuit.

**Coil Construction**—The coils are wound separately on moulds or micarta tubes. This permits careful inspection and testing at all stages of manufacture. The high-voltage coils are divided into a number of sections to reduce the voltage stress between layers.

**Magnetic Circuit**—The magnetic circuit is built up of L-shaped punchings of non-aging silicon steel, graded and selected in the same manner as described for the distributed-shell-type design. This insures a low iron loss while the low induction and the use of L-shaped punchings results in a uniformly low exciting current.

**Assembly**—The coils are first assembled complete and then an exact weight of L-punchings is built up, piece by piece, thus insuring uniformity of the iron loss and exciting current.

**Impregnation**—All coils are impregnated by the vacuum process as described for "Distributed-Shell Transformers."

**Mechanical Details**—In general the advantages cited previously for the distributed-shell transformers apply equally to the rectangular-core trans-

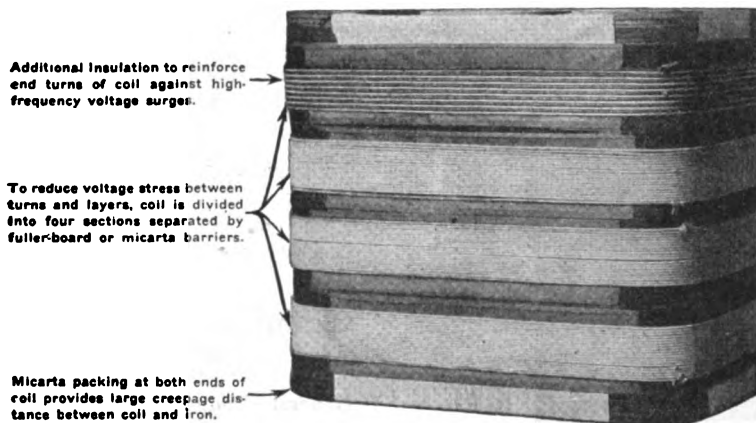


FIG. 13—HIGH-VOLTAGE COIL OF RECTANGULAR-CORE (TYPE SK) TRANSFORMER Showing Reinforced Winding

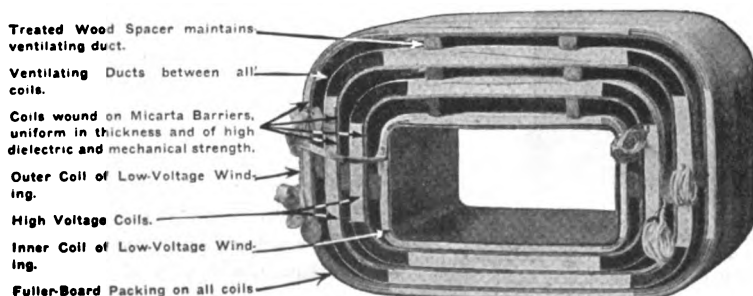


FIG. 14—COIL GROUP OF LARGE-CAPACITY RECTANGULAR-CORE (TYPE SK) TRANSFORMER



## DISTRIBUTION TRANSFORMERS—Continued

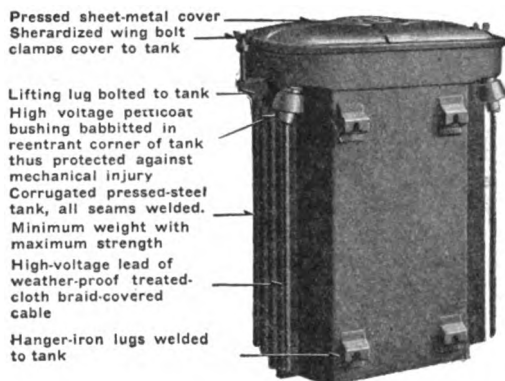


FIG. 15—13,800-VOLT TYPE SK TRANSFORMER IN CAST-IRON TANK

formers. The high-voltage bushings of the 22,000-volt transformers are cemented into a cast iron bushing which is screwed into the case. These bushings are packed and shipped separately to protect them against breakage.

**Application**—The type SK transformer is designed for single-phase service, pole or platform mounting. The most general field of application is for distribution voltages from 4600 up to 23,000 volts.

The type SKA transformer has a lower efficiency, smaller size of parts and consequently a lower price than a type SK transformer of the same rating. In other respects however, it is equal to the type SK transformer. The conditions under which the type SKA transformer can advantageously be used instead of the type SK are the same as cited previously for the type SA transformer.

The type SKM transformer is the type SK transformer arranged for manhole service and therefore is provided with a special water-proof tank and bushings. The details of the tank and bushing

construction are, in general, the same as described under "Type SM Transformers."

The type ST transformer is similar in general construction to the type SK transformer except that, being designed for three-phase service, it has three sets of coils.

The type STM transformer is the type ST transformer adapted for manhole service by special tanks and bushings. The mechanical construction of tanks and bushings is, in general, the same as that previously outlined for type SM transformers.

## CRUCIFORM-CORE—TYPES SC AND SCT

**General**—The cruciform-core form of construction has circular concentric coils assembled with a core of cruciform cross-section. The punchings are clamped top and bottom by angle or channel irons. The tanks are of boiler iron in the smaller sizes and have corrugated sheet-iron walls with cast-on top-flange and base in the larger. The transformers are held in position in the tank by means of wrought iron supports and centering blocks at the bottom of the tank.

Circular coils naturally possess considerable mechanical strength and can be readily insulated. Therefore they are particularly well adapted for transformers of high voltage and small capacity, requiring a relatively small size wire. The cruciform core also provides for a large cross-section of iron within the circular coils, in other words, gives a good space factor. This design, therefore, gives the necessary mechanical and dielectric strength for a high-voltage transformer, together with a satisfactory performance. It is in fact the ideal design for this particular field of service.

**Insulation**—The insulation between windings consists of unbroken circular barriers. The high-voltage coils are taped and insulated from each other by additional barrier insulation or by oil ducts.

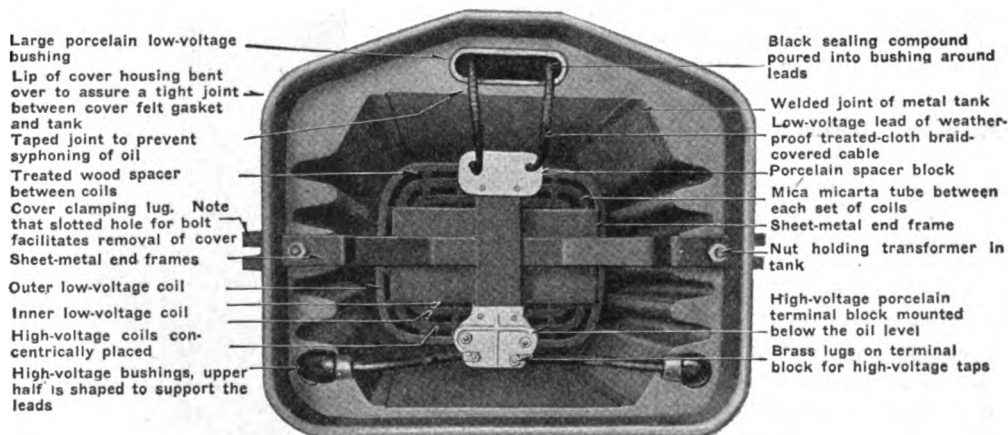
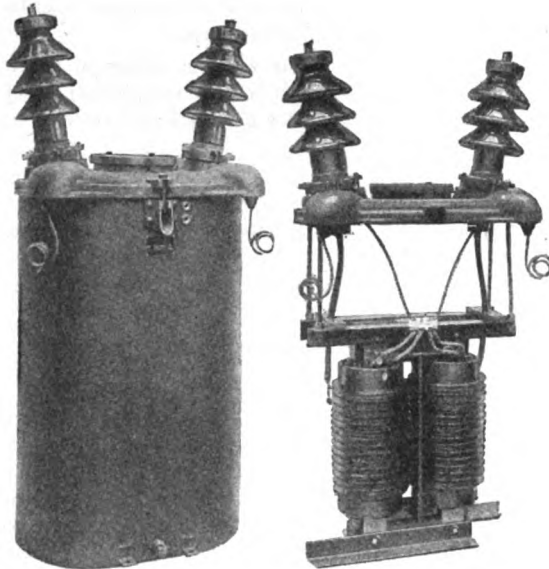


FIG. 16—TOP VIEW (COVER REMOVED) OF 13,800-VOLT TYPE SK TRANSFORMER IN CAST-IRON TANK

## DISTRIBUTION TRANSFORMERS—Continued



In Boiler-Iron Tank  
Coils and Iron  
FIG. 17—TYPE SC (CRUCIFORM-CORE) TRANSFORMER

**Coil Construction**—The high and low-voltage coils are wound separately on moulds or insulating tubes. The high-voltage winding is built up of a number of circular coils. The low-voltage coils are wound with a circular insulating barrier between layers.

**Magnetic Circuit**—I-plate punchings of different widths to give a cruciform cross-section inside the coils, are assembled and held together by insulated rivets. The punchings are non-aging silicon steel, double annealed to insure uniform magnetic characteristics.

**Assembly**—The high and low-voltage coils are assembled and placed over the legs of the magnetic circuit, which is completed by placing the yoke punchings in position.

**Impregnation**—All coils are impregnated by the vacuum process. The process is the same as previously described under "Distributed-Shell Transformers."

**Mechanical Details**—The smaller transformers are mounted in boiler-iron tanks and are suspended from a cast-iron cover in which the bushings are mounted. This permits the transformer with cover and bushings to be removed intact from the tank. The sheet-iron cast-in tanks used with the larger sizes have a large radiating surface for a given floor space. Lifting lugs are provided on the top-flange.

**Application**—Type SC transformers are for single-phase service, platform mounting. The general field of service is for the highest distribution voltages in use today, such as 34,500 volts.

Type SCT transformers are for three-phase service, platform mounting.

## SIMPLE-SHELL—TYPE SS

**General**—These transformers are constructed with flat pan-cake coils arranged vertically and assembled with a built-up shell of steel punchings. The construction used is the same as for Westinghouse shell-type power transformers of large capacity.

This design is best suited for large units because it lends itself to a uniform ventilation of the coils—especially important where a large amount of heat has to be dissipated—and also because the coils can be most effectively braced against the mechanical shocks of short circuits.

**Insulation**—The insulation between turns, layers, or coil sections consists of barriers or layers of fullerboard or treated paper. The end turns are reinforced against high-frequency surges and a large creepage distance between coils is provided by extending the barrier insulation between individual coils.

**Coil Construction**—The flat pan-cake coils are of copper strap and are wound separately on moulds in either single or double sections. One side of each coil is exposed to the oil, the other being insulated by a fullerboard or paper barrier.

**Magnetic Circuit**—The magnetic circuit is built up of I-plates of non-aging double-annealed silicon steel.

**Assembly**—The coils are assembled complete with insulating barriers and then an exact weight

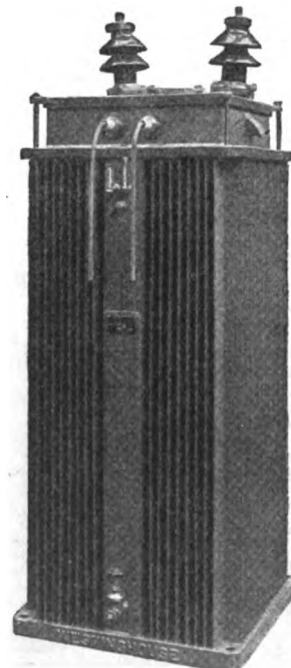


FIG. 18—TYPE SS TRANSFORMER IN TANK OF CORRUGATED SHEET-IRON SIDES WITH BASE AND TOP-FLANGE CAST-ON

4-108A

DISTRIBUTION TRANSFORMERS—Continued

of I-plate punchings is built up around the coils. Heavy structural iron end-frames clamp the magnetic circuit and steel plates with tie rods support the ends of the coils, preventing mechanical distortion in case of a short circuit.

**Impregnation**—All coils are varnished, and, after assembly, the complete transformer is dried out and oil impregnated by the vacuum process. The process is similar to that described under "Distributed-Shell Transformers," except that the transformers are impregnated with an oil instead of a resinous compound.

**Mechanical Details**—The transformers are mounted in sheet-iron cast-in tanks, centered by wooden centering blocks and held in position by wrought-iron supports. Lifting lugs are provided on the upper flange of the tank.

**Application**—Type SS transformers are for single-phase outdoor service and have their field of application for 25-cycle circuits of relatively large capacity.

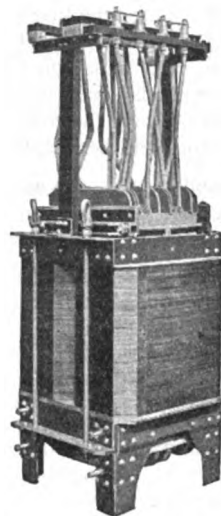


FIG. 19—COILS AND IRON OF SIMPLE-SHELL (TYPE SS) TRANSFORMER

AUXILIARY APPARATUS

Accessories for Westinghouse Distribution Transformers are furnished in accordance with the following table which is the standardization adopted by the Electric Power Club and the National Electric Light Association.

Voltage Class	ACCESSORIES							
	Standard Indicating Thermometer	Oil Gauge	Oil Drain Valve	Oil Drain Plug	Oil Test Valve	Provision For Filter Press Connection	Hanger Irons	Fuse Blocks
<b>60 Cycles</b>								
440	250L	150L	150L	100S	150L	150L	50S	10S
550	250L	150L	150L	100S	150L	150L	50S	15S
2300	250L	150L	150L	100S	150L	150L	50S	50S
4600	250L	150L	150L	100S	150L	150L	50S	NOTE—No fuse blocks are regularly furnished with transformers in the 4600-volt class or in higher voltage classes.
6600	250L	150L	150L	100S	150L	150L	50S	
11000	250L	150L	150L	100S	150L	150L	50S	
13200	250L	150L	150L	100S	150L	150L	50S	
22000	250L	50L	50L	37.5S	50L	50L	NOTE—No Hanger irons are regularly furnished with transformers in the 22000-volt class or in higher voltage classes.	
33000	250L	50L	50L	37.5S	50L	50L		
44000	250L	50L	50L	37.5S	50L	50L		
66000	250L	50L	50L	37.5S	50L	50L		
<b>25 Cycles</b>								
440	150L	75L	75L	50S	75L	75L	25S	10S
550	150L	75L	75L	50S	75L	75L	25S	15S
2300	150L	75L	75L	50S	75L	75L	25S	50S
4600	150L	75L	75L	50S	75L	75L	25S	NOTE—No fuse blocks are regularly furnished with transformers in the 4600-volt class or in higher voltage classes.
6600	150L	75L	75L	50S	75L	75L	25S	
11000	150L	75L	75L	50S	75L	75L	25S	
13200	150L	75L	75L	50S	75L	75L	25S	
22000	150L	25L	25L	15S	25L	25L	NOTE—No Hanger irons are regularly furnished with transformers in the 22000-volt class or in higher voltage classes.	
33000	150L	25L	25L	15S	25L	25L		
44000	150L	25L	25L	15S	25L	25L		
66000	150L	25L	25L	15S	25L	25L		

NOTE—The figure and letter L indicate that the designated kv-a. and larger is furnished with the accessory listed at the head of the column. The figure and letter S indicate that the designated kv-a. and smaller is furnished with the accessory listed at the head of the column.

HANGER IRONS

Those transformers adapted for mounting directly on the cross-arm of poles are supplied with two-piece hanger irons. These are of steel, bent to engage standard cross-arms, and punched to fit the lugs on the backs of the transformer tanks.

FUSE BLOCKS, FUSE BOXES AND FUSES

Distribution transformers are normally protected on the high-voltage side by fuse blocks or boxes. Four types of these fuse blocks and boxes are listed in section 1-B: plug type, expulsion type, safety-first type and disconnecting-switch type.

DISTRIBUTION TRANSFORMERS—Continued

**Plug Type**—The plug-type fuse block consists of a porcelain receptacle and plug. The receptacle is mounted on the pole cross-arm and is provided with suitable terminals for line connection. The fuse is connected between the contacts of the plug, which engage contacts in the receptacle.

The above fuse blocks can be used on circuits up to and including 2500 volts at 30 amperes maximum or 3300 volts at 12 amperes maximum.

**Expulsion Type**—The expulsion-type fuse box is used with transformers of higher capacities and voltages. It is weatherproof and can be mounted on the pole cross-arms or any other place convenient to the transformer.

This block consists of a wooden box having mounted therein an expulsion tube within which is placed the fuse wire. A hinged door permits easy access for the purpose of inspection or replacement of the fuses.

This type of fuse box can be used on circuits of 2300 and 3300 volts at 60 amperes and on 6900 volts at 30 amperes.

**Type OD Safety-First Fuse Box**—The type OD fuse box is of the expulsion-type similar to that already described but embodying a number of features that provide perfect safety in operation. The fuse tube is mounted on the 7500-volt insulators on the door of the box in such a manner that it is readily detachable for re-fusing. Complete separation of those parts to be handled from all live parts is accomplished automatically by opening the door. On closing the door, contacts on the fuse tube engage other contacts mounted on insulators on the back of the box and a latch assures good contact by holding the door tightly closed.

This type of box is made in two sizes; one for 30 amperes maximum, 7500 volts, and the other for 100 amperes maximum, 7500 volts.

**Disconnecting-Switch Type**—The disconnecting-switch type of expulsion fuse block is used for still higher voltages. This fuse block has a capacity of 50 amperes on all voltages from 6600 to 73,000. The fuse tube should be removed and inserted by a special fuse pole, one or more of which should be supplied for each installation.

**Fuse Wire**—Standard aluminum fuse wire listed in section on "Knife Switches and Miscellaneous

Wiring Devices" is used, but not included, with all of the fuse blocks described above.

**APPLICATION OF LIGHTNING ARRESTERS AND FUSE BLOCKS**

The following list of lightning arresters, fuses, and fuse blocks is recommended for use in the protection of Westinghouse distribution transformers. For more complete information on the correct type of lightning arresters, fuses, or fuse blocks for use on a given installation of distribution transformers, refer to Sections 1-A, 1-B, or 1-C of this catalogue.

LIGHTNING ARRESTERS		
Voltage of Arresters	Type of Arresters	Remarks
400	MP	Multi-path—unlimited application.
750	MP	Multi-path—unlimited application.
1000-2500	C	Multi-gap—limited application and for use on 60-cycle service only.
1000-5000	CR	Series Resistance Type—unlimited application—For the usual 2500-volt service install iron box arrester style No. 240916 or wood box arrester style No. 272985.
3000-13200	W	Series Resistance Type—unlimited application.
2000-7500	S	Shunt resistance type—limited application.
2000-39000	LE	Shunt resistance type—unlimited application.
2500-15000	LV	Autovalve
1000 and up	AK	Electrolytic type.
22000 and up	AL	Electrolytic type with impulse gaps.

FUSE BLOCKS		
Voltage Range	Current Range Amperes	Type of Fuse Blocks
0-2500	30	Plug Type
0-7500	30 and 100	OD Safety-First Type
15000-66000	50	Expulsion and Disconnecting Switch Type

**OIL**

Westinghouse Wemco A oil is regularly supplied with Westinghouse distribution transformers. Wemco A oil is a pure mineral oil free from moisture, acid, alkali, or sulphur compounds and is very fluid. It is not affected by temperatures reached under ordinary operating conditions and has a high breakdown voltage. For additional information on Wemco A oil refer to section on "Insulating Materials and Supplies."

All transformers up to and including 22,000 volts, 200 kv-a. capacity are shipped with the oil in separate containers. If shipped with oil in the tank, there is seepage of oil through the cover gasket during transportation.

## DISTRIBUTION TRANSFORMERS—Continued

## OMISSION ALLOWANCES

The following deductions are to be made from the net prices obtained by applying the discounts specified on the discount sheets for this section:

**Oil**—If oil is omitted with any of these transformers, a deduction may be made from the net price of the transformers of \$0.20 per gallon.

**Fuse Blocks**—If fuse blocks, Style Nos. 147190 or 29865, are omitted with any of the

transformers for which they are regularly supplied, a deduction of \$0.75 for each block may be made from the net price of the transformer.

When hanger irons are not desired with the transformers with which they are normally supplied, a deduction from the net price of the transformer may be made. For these omission allowances refer to the nearest district office.

## INSTRUCTIONS FOR ORDERING

**Style Number** includes transformer only.

**List Price** includes transformer complete and, except as noted, the following:

Oil in quantity as specified in tables.

**Hanger Irons**, the style numbers of which are shown in the tables. Where no hanger iron style number for a particular transformer is shown in the tables, the transformer is intended for platform mounting and hanger irons are not included.

**Fuse Blocks**—One set of fuse blocks, complete with lag screws, is included in the list price of the transformer for voltages up to 2300, except where otherwise noted in the tables. Fuse blocks are not included in the price of transformers for voltages of 4600 or higher. Fuse wire or links are not included with fuse blocks and must be ordered separately from section on "Knife Switches and Miscellaneous Wiring Devices."

**On Ordering, Specify as Separate Items:**

**Transformer**—State the capacity, phase, frequency, high and low voltages, and the style number.

**Oil**—Specify the gallons of oil required for each transformer. The quantity required is given in the tables.

**Hanger Irons**—Order by the style number shown in the tables. (Style number includes a pair of hanger-irons.)

**Fuse Blocks**—Where the list price includes fuse blocks, either Style No. 29865 or Style No. 147190 can be ordered, as desired. Order two for each single-phase transformer or three for each three-phase.

**Fuse Wire and Links**—Order by description and list price shown in section on "Knife Switches and Miscellaneous Wiring Devices."

## Ratings

**Capacity and Voltage**—The capacity and voltage ratings of Westinghouse distribution transformers are in agreement with the recommendations of the

Apparatus Committee of the National Electric Light Association, and the Electric Power Club, determined under the conditions specified in the standardization rules of the American Institute of Electrical Engineers.

**Secondary Voltage Classes**—To facilitate listing, the low-voltage windings are given in three classes: Class 200, Class 400 and Class 500. Class 200 transformers are those whose highest low-voltage winding is nominally 200 volts (220, 230, 240). In like manner, class 400 transformers are those whose highest low-voltage winding is nominally 400 volts (440, 460, 480); and class 500 transformers are those whose highest low-voltage winding is nominally 500 volts (550, 575, 600).

All low-voltage windings of 480 volts and lower for single-phase transformers of capacities up to 100 kilovolt-amperes, are separated into two independent groups, the leads from which are brought out through the case. These two groups can be connected in multiple for the lower voltage and in series for the higher voltage; when connected for the higher voltage, the series connection may be used as the neutral lead for a three-wire circuit. Single-phase transformers of capacities above 100 kilovolt-amperes and with low-voltage windings for Class 200 are provided with low-voltage leads out of the case for 230 volts two-wire operation or for 230–115 volts three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.

In the tables listing the transformers, the high voltage rating is given first, separated by the word "to" from the low-voltage rating.

**Frequency**—Single-phase transformers are listed for use on 25 and 60-cycle circuits. For other frequencies, prices will be furnished on request.

**Polarity**—Transformers up to and including 200 kv-a. and 7500 volts are of additive polarity. Transformers of higher voltage or larger capacity are of subtractive polarity.

DISTRIBUTION TRANSFORMERS—Continued

SINGLE-PHASE 60-CYCLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Cap. Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		ORDERING DATA			List Price	
		Catalogue Page No.	Dim. Reference	Dim. A	Dim. H	Net	Shipping†	Style No. Transformer Only	Style No. Hanger Iron		Gallons Oil
440 to 220-110 Volts } 460 to 230-115 Volts } (Class 200) 480 to 240-120 Volts }											
1½	S	637	1½-23	15¼	7	85	110	381878	109712	1½	853 00
3	S	637	3-23	16¼	7	138	170	381879	109712	1½	77 00
5	S	637	5-23	17¼	7	195	225	381880	109712	3½	103 00
7.5	S	637	7½-23	21	7	277	335	381881	109712	6	135 00
10	S	637	7½-23	28½	11	342	400	381882	109712	9¼	164 00
15	S	637	7½-23	28½	11	383	440	381883	109712	9	216 00
25	S	637	25-23	34¼	19½	665	735	381884	234482	18½	314 00†
37.5	S	637	37½-23	44¼	23	987	1075	381885	234482	31	422 00†
50	S	637	37½-23	50¼	27	1154	1250	381886	129384	37	519 00†

550 to 220-110 Volts } 575 to 230-115 Volts } (Class 200) 600 to 240-120 Volts }											
1½	S	637	1½-23	15¼	7	72	95	317250	109712	1½	53 00
3	S	637	3-23	16¼	7	111	145	317292	109712	1½	77 00
5	S	637	5-23	17¼	7	148	186	258771	109712	3½	103 00
7.5	S	637	5-23	19¼	7	202	234	258772	109712	4½	135 00
10	S	637	7½-23	23½	11	286	340	258773	109712	7	164 00
15	S	637	7½-23	28½	11	325	378	258774	109712	9	218 00
25	S	637	20-23	31¼	19½	513	581	258776	234482	14	314 00†
37.5	S	637	37½-23	37¼	23	908	987	258778	234482	22¼	422 00†
50	S	637	37½-23	44¼	27	1017	1142	258779	234482	31	519 00†

Cap. Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		ORDERING DATA			List Price
		Catalogue Page No.	Dim. Reference	Dim. A	Dim. H	Net	Shipping†	STYLE NO. TRANSFORMER ONLY	Style No. Hanger Iron	
2200 to 220-110 Volts } 2300 to 230-115 Volts } (Class 200) 2400 to 240-120 Volts }										
2200 to 440-220 Volts } 2300 to 460-230 Volts } (Class 400) 2400 to 480-240 Volts }										

High Efficiency Type

1½	S	637	1½-23	15¼	7	84	107	317251	.....	109712	1½	853 00
3	S	637	3-23	16¼	7	138	170	317293	317294	109712	1½	77 00
5	S	637	5-23	17¼	7	195	225	222564	223364	109712	3½	103 00
7.5	S	637	7½-23	21	11	277	335	222565	223365	109712	6	135 00
10	S	637	7½-23	28½	11	342	400	326424	326425	109712	9¼	164 00
15	S	637	7½-23	28½	11	383	440	222567	223367	109712	9	218 00
25	S	637	25-23	34¼	19½	665	735	329757	329758	234482	18½	317 00
37.5	S	637	37½-23	44¼	28	987	1075	334304	334305	234482	31	424 00
50	S	637	37½-23	50¼	33	1154	1250	382747	382748	129384	37	522 00
75	SK	637	75-23	54¼	.....	1740	1900	360092	360093	.....	72	653 00
100	SK	637	75-23	66	.....	2040	2260	359257	359258	.....	93	785 00†
150	SK	639	100-66	56¼	.....	3310	3740	281691	287132	.....	118	993 00†
200	SK	639	100-66	74¼	.....	3560	4000	281692	287133	.....	172	1146 00†

Reduced Efficiency Type

1½	SA	637	1½-23	15¼	7	72	95	317257	.....	109712	1½	44 00
3	SA	637	3-23	16¼	7	105	140	317300	268485	109712	1½	65 00
5	SA	637	5-23	17¼	7	147	185	261474	268486	109712	3½	87 00
7.5	SA	637	7½-23	21	11	200	258	261475	268487	109712	6	117 00
10	SA	637	7½-23	28½	11	272	320	261476	268488	109712	10	142 00
15	SA	637	20-23	27¼	16	374	450	261477	268489	109712	12	190 00
25	SA	637	25-23	34¼	19½	575	648	261479	268490	234482	18½	273 00
37.5	SA	637	37½-23	44¼	27	838	930	261481	268491	234482	34	362 00
50	SA	637	75-23	44	27¼	1254	1390	379492	268492	234482	59	443 00
75	SKA	637	75-23	54¼	.....	1405	1560	300933	267095	.....	75	587 00†
100	SKA	637	75-23	72¼	.....	1976	2176	300934	267096	.....	115	727 00†

†Shipping weight includes transformer boxed for shipment, complete with hanger irons and fuse blocks (when supplied) and oil in container.

‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus").

§Hanger irons are not included with this capacity.

¶Low-voltage winding is arranged for 230 volts, two-wire and 230-115 volts three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.

Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.

NOTE—All of the above single-phase transformers can be operated in bank on three-phase with the high-voltage windings connected in star or in delta.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

SINGLE-PHASE 60-CYCLE TRANSFORMERS—Continued

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		ORDERING DATA			List Price	
		Catalogue Page No.	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	Style No. Transformer Only	Style No. Hanger Iron		Gallons Oil
2200 to 550 Volts } 2300 to 575 Volts } (Class 500) 2400 to 600 Volts }											
1½	S	637	1½-23	15¼	7	84	107	317256	109712	1½	\$ 53 00
3	S	637	3-23	16¼	7	138	170	379531	109712	1½	77 00
5	S	637	5-23	17¼	7	195	225	268576	109712	3½	103 00
7.5	S	637	7½-23	21	11	277	335	268577	109712	6	135 00
10	S	637	7½-23	28¼	11	342	400	379532	109712	9¼	164 00
15	S	637	7½-23	28¼	11	383	440	268579	109712	9	218 00
25	S	637	25-23	34¼	19½	665	735	379533	234482	18½	317 00
37.5	S	637	37½-23	44¼	27	987	1075	379534	234482	31	424 00
50	S	637	37½-23	50¼	33	1154	1250	382755	129384	37	522 00
75	SK	637	75-23	54¼	....	1740	1900	268583	.....	70	653 00†
100	SK	637	75-23	66	....	2040	2260	268584	.....	93	785 00†
150	SK	639	100-66	56¼	....	3310	3740	268585	.....	118	993 00†
200	SK	639	100-66	74¼	....	3560	4000	268586	.....	170	1146 00†

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		ORDERING DATA			List Price		
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	STYLE NO. TRANSFORMER ONLY	Style No. Hanger Iron		Gallons Oil	
4400-2200 to 220-110 Volts } 4600-2300 to 230-115 Volts } (Class 200) 4800-2400 to 240-120 Volts }												
4400-2200 to 440-220 Volts } 4600-2300 to 460-230 Volts } (Class 400) 4800-2400 to 480-240 Volts }												
1½	S	637	5-23	17¼	7	136	166	326765	368334	109712	4½	\$ 72 00†
3	S	637	5-23	17¼	7	172	202	326767	368335	109712	3½	96 00†
5	S	637	7½-23	21	11	234	290	326768	368336	109712	5½	122 00†
7.5	S	637	7½-23	21	11	270	330	326769	368337	109712	5	157 00†
10	S	637	20-23	27¼	16	405	470	326770	368338	109713	11½	187 00†
15	S	637	25-23	30¼	19½	573	643	326771	368339	234482	14	242 00†
25	S	637	25-23	42	23	711	800	326772	364945	234482	25	348 00†
37.5	SK	637	75-23	44	27¼	1150	1250	326773	368368	129384	59	461 00†
50	SK	637	75-23	44	27¼	1210	1253	326774	368369	129384	56	562 00†
75	SK	637	75-23	54¼	....	1600	1800	326775	368370	.....	75	702 00†
100	SK	637	75-23	66	....	1980	2180	326776	368371	.....	100	833 00†
150	SK	639	100-66	69¼	....	3410	4200	326777†	368372	.....	153	1037 00†
200	SK	639	100-66	80¼	....	3700	4600	326778†	368373	.....	183	1200 00†

6600-6300-6000-5700 to 220-110 Volts } 6900-6585-6275-5960 to 230-115 Volts } (Class 200) 7200-6875-6545-6220 to 240-120 Volts }												
6600-6300-6000-5700 to 440-220 Volts } 6900-6585-6275-5960 to 460-230 Volts } (Class 400) 7200-6875-6545-6220 to 480-240 Volts }												
1.5	SK	639	1-66	18¼	10	150	180	267164	267175	109713	3½	98 00†
3	SK	639	2-66	21¼	10	205	240	267165	267176	109713	5	117 00†
5	SK	639	5-66	23¼	10	260	305	267166	267177	109713	7	142 00†
7.5	SK	639	7½-66	25¼	16	402	452	267167	267178	109713	11½	177 00†
10	SK	639	7½-66	25¼	16	434	484	267168	267179	109713	11	211 00†
15	SK	639	15-66	31	18	660	720	267169	267180	109714	17	268 00†
25	SK	639	25-66	36	21	1010	1110	267170	267181	109714	26	378 00†
37.5	SK	637	75-23	44	27¼	1138	1275	305138	305125	129384	57	496 00†
50	SK	637	75-23	44	27¼	1224	1360	305139	305126	129384	55	600 00†
75	SK	637	75-23	54¼	....	1580	1758	305140	305127	.....	75	738 00†
100	SK	637	75-23	66	....	1905	2105	305141	305128	.....	97	857 00†
150	SK	639	100-66	69¼	....	3500	4200	281697†	267187	.....	153	1083 00†
200	SK	639	100-66	80¼	....	3800	4600	281698†	267188	.....	183	1275 00†

†Shipping weight includes transformer boxed for shipment, complete with hanger irons and fuse blocks (when supplied) and oil in container.

‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus").

§Hanger irons are not included with this capacity.

¶Low voltage winding is arranged for 230 volts, two-wire, and 230-115 volts three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.

Oil weighs approximately 7 pounds net per gallon and 8¼ pounds shipping.

NOTE—All of the above single-phase transformers can be operated in bank on three-phase with the high-voltage winding connected in star or in delta.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

SINGLE-PHASE 60-CYCLE TRANSFORMERS—Continued

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		ORDERING DATA				List Price		
		Catalogue Page No.	Dim. Ref.	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	STYLE No. TRANSFORMER ONLY	Style No. Hanger Iron	Gallons Oil			
11000-10450- 9900 to 220-110 Volts					(Class 200)		11000-10450- 9900 to 440-220 Volts				(Class 400)		
11500-10925-10350 to 230-115 Volts							11500-10925-10350 to 460-230 Volts						
2.5	SK	639	2½	110	26	16	308	350	308944	308954	109713	7½	\$ 165 00
5	SK	639	5	-110	27¼	16	454	510	308945	308955	109713	12	208 00
10	SK	639	15	-110	32½	18	656	760	308946	308956	109713	18	269 00
15	SK	639	15	-110	32½	18	676	780	308947	308957	109714	18	329 00
25	SK	639	30	-66	36¼	24	1113	1240	308948	308958	109715	34	437 00
37.5	SK	637	75	-23	44	27¾	1100	1240	308949	308959	129384	59	560 00
50	SK	637	75	-23	44	27¾	1172	1300	308950	308960	129384	56	667 00
75	SK	637	75	-23	54¼	....	1625	1825	307131	307132	†	75	825 00
100	SK	637	75	-23	66	....	2062	2262	308951	308961	†	96	967 00
150	SK	639	100	-66	69¼	....	3470	4100	379115†	379116	†	153	1212 00
200	SK	639	100	-66	80¼	....	3980	4700	379117†	379118	†	183	1412 00
13200-12540-11880 to 220-110 Volts					(Class 200)		13200-12540-11880 to 440-220 Volts				(Class 400)		
13800-13110-12420 to 230-115 Volts							13800-13110-12420 to 460-230 Volts						
2.5	SK	639	2½	110	26	16	307	350	308964	308974	109713	7½	198 00
5	SK	639	5	-110	27¼	16	454	510	308965	308975	109713	12	236 00
10	SK	639	15	-110	32½	18	656	760	308966	308976	109713	18	303 00
15	SK	639	20	-66	32	21	848	950	308967	308977	109714	24	369 00
25	SK	639	30	-66	36¼	24	1113	1240	308968	308978	109715	34	479 00
37.5	SK	637	75	-23	44	27¾	1058	1200	308969	308979	129384	59	595 00
50	SK	637	75	-23	44	27¾	1158	1300	308970	308980	129384	54	689 00
75	SK	637	75	-23	66	....	1822	2022	366535	366536	†	96	850 00
100	SK	637	75	-23	66	....	2034	2234	308971	308981	†	92	992 00
150	SK	639	100	-66	69¼	....	3470	4100	379068†	379069	†	153	1234 00
200	SK	639	100	-66	80¼	....	3830	4650	379070†	379071	†	183	1438 00
22000-20900-19800 to 220-110 Volts					(Class 200)		22000-20900-19800 to 440-220 Volts				(Class 400)		
23000-21850-20700 to 230-115 Volts							23000-21850-20700 to 460-230 Volts						
5	SK	640	5	-220	38¼	....	605	750	308984	308994	†	15	429 00
10	SK	640	10	-220	39¼	....	882	1042	308985	308995	†	26	490 00
15	SK	640	15	-220	41	....	1010	1250	308986	308996	†	30	538 00
25	SK	640	25	-220	42½	....	1373	1673	308987	308997	†	39	631 00
37.5	SK	640	37½	-220	47½	....	1757	2070	308988	308998	†	51	743 00
50	SK	640	50	-220	50	....	2092	2460	308989	308999	†	56	842 00
75	SK	640	75	-220	56¼	....	2655	3100	308990	307000	†	90	1034 00
100	SK	640	75	-220	64	....	3000	3650	308991	307001	†	108	1196 00
150	SK	640	125	-220	63	....	4135	4900	317911†	317910	†	148	1412 00
200	SK	640	125	-220	80	....	4950	5800	379054†	379055	†	200	1618 00
33000-31350-29700 to 220-110 Volts					(Class 200)		33000-31350-29700 to 440-220 Volts				(Class 400)		
34500-32775-31050 to 230-115 Volts							34500-32775-31050 to 460-230 Volts						
10	SC	643	1	67	....	....	1040	1150	267489	267490	†	43	547 00
15	SC	643	1	67	....	....	1060	1200	267491	267492	†	43	599 00
25	SC	643	3	73	....	....	1460	1640	267493	267494	†	70	692 00
37.5	SC	643	4	79	....	....	1710	1970	267495	267496	†	80	803 00
50	SC	643	8	91	....	....	2580	2780	267497	267498	†	160	906 00
75	SC	643	24	89	....	....	3640	3800	267499	267500	†	170	1096 00
100	SC	643	24	89	....	....	3720	4290	267501	267502	†	165	1275 00
150	SC	643	26	98	....	....	4250	4800	267505†	267506	†	180	1592 00
200	SC	643	36	92	....	....	6000	6720	267507†	267508	†	215	1771 00

†Shipping weight includes transformer boxed for shipment, complete with hanger irons (when supplied) and oil in container.  
 ‡Hanger irons are not included with this capacity.  
 §Low voltage winding is arranged for 230 volts two-wire and 230-115 volts three-wire operation but the low voltage coils cannot be connected in parallel for 115 volts.  
 Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.  
 NOTE—The above transformers are suitable for delta-connection but not suitable for star-connection on the high-voltage side when banked for three-phase operation.

Order by Style Number



## DISTRIBUTION TRANSFORMERS—Continued

## SINGLE-PHASE 60-CYCLE TRANSFORMERS—Continued

## FOR SUPPLYING DISTRIBUTION VOLTAGES ABOVE 600 VOLTS

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		Style No. Transformer Only	ORDERING DATA		List Price	
		Catalogue Page No.	Dim. Reference	Dim. A	Dim. H	Including Oil Net		Shipping†	Style No. Hanger Iron		Gallons Oil
<b>‡6600-6270-5940 to 2300 Volts</b>											
1.5	SK	639	2 - 66	21 1/4	10	217	265	267189	109713	6	\$102 00
3	SK	639	2 - 66	21 1/4	10	227	267	267190	109713	5	128 00
5	SK	639	7 1/2 - 66	25 1/2	16	423	473	267191	109713	11	157 00
7.5	SK	639	7 1/2 - 66	25 1/2	15	454	504	267192	109713	10 1/2	195 00
10	SK	639	7 1/2 - 66	25 1/2	16	460	510	267193	109713	10	232 00
15	SK	639	15 - 66	31	18	660	720	267194	109714	16	295 00
25	SK	639	25 - 66	36	21	1010	1110	267195	109714	26	415 00
37.5	SK	637	75 - 23	44	27 1/4	1138	1275	305182	129384	59	521 00
50	SK	637	75 - 23	44	27 1/4	1224	1360	305183	129384	56	630 00
75	SK	637	75 - 23	54 1/4	....	1578	1758	305184	129384	75	775 00
100	SK	637	75 - 23	66	....	1905	2105	305185	129384	95	900 00
150	SK	639	100 - 66	69 1/4	....	3410	4200	267201	129384	153	1083 00
200	SK	639	100 - 66	80 1/4	....	3800	4600	267202	129384	186	1275 00
<b>‡11000-10450-9900 to 2300 Volts</b>											
2.5	SK	639	5 - 110	27 1/4	16	434	489	307004	109713	12	173 00
5	SK	639	5 - 110	27 1/4	16	465	525	307005	109713	11 1/2	218 00
10	SK	639	15 - 110	32 1/2	18	649	750	307006	109714	17	282 00
15	SK	639	20 - 66	32	21	848	950	307007	109714	24	329 00
25	SK	639	30 - 66	36 1/4	24	1113	1240	307008	109715	34	437 00
37.5	SK	637	75 - 23	44	27 1/4	1093	1230	307009	129384	59	560 00
50	SK	637	75 - 23	44	27 1/4	1172	1310	307010	129384	56	667 00
75	SK	637	75 - 23	54 1/4	....	1625	1780	267231	129384	75	825 00
100	SK	637	75 - 23	66	....	2062	2262	307011	129384	96	967 00
150	SK	639	100 - 66	69 1/4	....	3470	4100	307012	129384	153	1212 00
200	SK	639	100 - 66	80 1/4	....	3960	4700	379131	129384	180	1412 00
<b>‡13200-12540-11880 to 2300 Volts</b>											
2.5	SK	639	5 - 110	27 1/4	16	434	489	307014	109713	12	208 00
5	SK	639	5 - 110	27 1/4	16	465	525	307015	109713	11 1/2	248 00
10	SK	639	15 - 110	32 1/2	18	649	750	307016	109714	18	303 00
15	SK	639	20 - 66	32	21	834	940	307017	109714	22	369 00
25	SK	639	30 - 66	36 1/4	24	1120	1250	307018	109715	35	479 00
37.5	SK	637	75 - 23	44	27 1/4	1093	1230	307019	129384	59	595 00
50	SK	637	75 - 23	44	27 1/4	1180	1320	307020	129384	56	689 00
75	SK	637	75 - 23	54 1/4	....	1625	1780	305151	129384	75	850 00
100	SK	637	75 - 23	66	....	2062	2260	307021	129384	96	992 00
150	SK	639	100 - 66	69 1/4	....	3460	4100	370205	129384	153	1234 00
200	SK	639	100 - 66	80 1/4	....	3825	4650	377815	129384	183	1438 00
<b>‡22000-20900-19800 to 2300 Volts</b>											
5	SK	640	5 - 220	38 1/4	....	605	750	307024	129384	15	429 00
10	SK	640	10 - 220	39 1/4	....	882	1042	307025	129384	26	490 00
15	SK	640	15 - 220	41	....	1010	1250	307026	129384	30	538 00
25	SK	640	25 - 220	42 1/2	....	1373	1673	307027	129384	38	631 00
37.5	SK	640	37 1/2 - 220	47 1/2	....	1757	2070	307028	129384	51	743 00
50	SK	640	50 - 220	49	....	2092	2460	307029	129384	59	842 00
75	SK	640	75 - 220	56	....	2655	3100	307030	129384	90	1034 00
100	SK	640	75 - 220	64	....	3000	3650	307031	129384	106	1196 00
150	SK	640	125 - 220	63	....	4135	4900	379056	129384	145	1412 00
200	SK	640	125 - 220	80	....	4950	5800	370580	129384	200	1818 00
<b>‡33000-31350-29700 to 2300 Volts</b>											
10	SC	643	1	70	....	1040	1150	247090	129384	43	547 00
15	SC	643	1	70	....	1060	1200	250384	129384	43	599 00
25	SC	643	3	76	....	1460	1640	247091	129384	70	692 00
37.5	SC	643	4	82	....	1710	1970	250385	129384	80	803 00
50	SC	643	8	94	....	2580	2780	247092	129384	160	906 00
75	SC	643	25	92	....	3640	3800	247093	129384	170	1096 00
100	SC	643	25	92	....	3720	4290	250386	129384	165	1275 00
150	SC	643	26	98	....	4250	4800	247094	129384	180	1592 00
200	SC	643	36	92	....	6000	6720	247095	129384	215	1771 00

†Shipping weight includes transformer boxed for shipment, complete with hanger irons (when supplied) and oil in container.

‡Can be operated 5 per cent above rated voltage.

§Hanger irons are not included with this capacity.

Oil weighs approximately 7 pounds net per gallon and 8 1/2 pounds shipping.

NOTE—With the exception of the 6600-volt transformers which can be star-connected for 11,430 volts, the above transformers are suitable for delta-connection but not suitable for star-connection on the high voltage side when banked for three-phase operation. The 2300-volt low-voltage windings can be star-connected for three-phase operation but 6600-volt transformers should not be star-connected on both high and low-voltage windings.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

THREE-PHASE 60-CYCLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		STYLE No.		ORDERING DATA			List Price
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	TRANSFORMER ONLY† Shipping†	A (Star)	B (Delta)	Style No. Hanger Iron	Gallons Oil	
2200-3810Y to 440-220 Volts } 2300-3984Y to 460-230 Volts } (Class 400) 2400-4157Y to 480-240 Volts }												
5	ST	638	5 -40	21 1/4	11	288	327	267362	307082	109712	6 1/2	\$ 160 00
7.5	ST	638	7 1/2 -40	24 1/2	16	338	392	267363	307083	109713	9	199 00
10	ST	638	7 1/2 -40	24 1/2	16	396	450	267364	307084	109713	9	235 00
15	ST	638	15 -40	28 3/4	16	537	580	267365	307085	109713	15	310 00
25	ST	638	25 -40	31 1/4	23 1/4	1036	1215	267366	307086	234482	25	434 00
37.5	ST	638	37 1/2 -40	29 1/2	29 1/2	1613	1825	267367	307087	129384	40	574 00
50	ST	638	37 1/2 -40	45 1/2	36 1/4	1755	2150	267368	307088	129384	48	704 00
75	ST	638	75 -23	40 3/4	....	2363	2870	267369	307089	↓	62	950 00†
100	ST	638	75 -23	54 1/4	....	2787	3300	267370	307090	↓	96	1165 00†
150	ST	638	125 -23	60	....	3834	4270	267372	307091	↓	142	1565 00†
200	ST	638	125 -23	70	....	4425	5400	267373	307092	↓	175	1828 00†

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		STYLE No.		ORDERING DATA			List Price
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	TRANSFORMER ONLY Shipping†	Transformer Only	Style No. Hanger Iron	Gallons Oil		
4400 to 440-220 Volts } 4600 to 460-230 Volts } (Class 400) 4800 to 480-240 Volts }												
5	ST	638	7 1/2 -40	24 1/4	16	520	620	267384	109713	10	\$ 214 00†	
7.5	ST	638	7 1/2 -40	24 1/4	16	520	620	267385	109713	10	257 00†	
10	ST	638	15 -40	28 1/2	16	630	740	267386	109713	13 1/2	294 00†	
15	ST	638	25 -40	31 1/2	23 1/4	893	1055	267387	234482	22 1/2	368 00†	
25	ST	638	37 1/2 -40	39 1/4	29 1/4	1556	1820	267389	129384	38	501 00†	
37.5	ST	638	37 1/2 -40	45 1/4	36 1/4	1760	2100	267390	129384	47	644 00†	
50	ST	638	75 -23	40 3/4	31 1/2	2414	2840	267391	129384	62	778 00†	
75	ST	638	75 -23	40 3/4	....	2611	3070	267392	↓	68	1043 00†	
100	ST	638	75 -23	54	....	2900	3360	267393	↓	100	1269 00	
150	ST	638	125 -23	58 1/4	....	3830	4420	267395	↓	160	1685 00†	
200	ST	638	125 -23	80 1/4	....	4715	5490	267396	↓	228	1967 00†	

6600-6270-5940 to 440-220 Volts } 6900-6555-6210 to 460-230 Volts } (Class 400) 7200-6840-6480 to 480-240 Volts }												
10	ST	638	15 -40	28 1/4	16	630	740	379601	109713	13 1/2	335 00†	
15	ST	638	25 -40	31 1/2	23 1/4	893	1055	379602	234482	22 1/2	406 00†	
25	ST	638	37 1/2 -40	39 1/4	29 1/4	1556	1820	379603	129384	38	537 00†	
37.5	ST	638	37 1/2 -40	45 1/4	36 1/4	1760	2100	379604	129384	47	684 00†	
50	ST	638	75 -23	40 3/4	31 1/2	2414	2840	379605	129384	62	817 00†	
75	ST	638	75 -23	40 3/4	....	2611	3070	379606	↓	68	1076 00†	
100	ST	638	75 -23	54	....	2900	3360	379607	↓	100	1302 00†	
150	ST	638	125 -23	58 1/4	....	3830	4420	379608	↓	160	1710 00†	
200	ST	638	125 -23	80 1/4	....	4715	5490	379609	↓	228	1973 00†	

11000-10450- 9900 to 440-220 Volts } 11500-10925-10350 to 460-230 Volts } (Class 400)												
10	ST	638	5 -165	29 1/4	16	620	735	379615	109713	18	352 00†	
15	ST	638	10 -165	31 1/4	18	799	955	379616	109714	25	428 00†	
25	ST	638	25 -165	42 1/4	24	1150	1380	379617	109715	40	566 00†	
37.5	ST	638	50 -23	41 1/4	30 1/4	1679	2000	379618	129384	47	719 00†	
50	ST	638	75 -23	46 1/4	37 1/4	1775	2120	379619	129384	55	860 00†	
75	ST	638	75 -23	54	....	2611	3000	379620	↓	68	1132 00†	
100	ST	638	125 -23	52 1/4	....	2850	3300	379621	↓	100	1369 00†	
150	ST	638	125 -23	62 1/4	....	3820	4400	379622	↓	160	1800 00†	
200	ST	638	125 -23	80 1/4	....	4715	5500	379623	↓	228	2077 00†	

†Shipping weight includes transformer boxed for shipment, complete with hanger irons (when supplied) and oil in container.

‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus").

§Hanger irons are not included with this capacity, as transformer is intended for platform mounting.

¶Style numbers in column A have the high-voltage coils connected in star for 3984 volts.

¶Style numbers in column B have the high-voltage coils connected in delta for 2300 volts.

Oil weighs approximately 7 pounds net per gallon and 8 1/2 pounds shipping.

NOTE—The high-voltage windings of the above three-phase transformers are connected in star and the low-voltage windings in delta, except as noted for the 2300-3984-volt transformers.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

THREE-PHASE 60-CYCLE TRANSFORMERS—Continued

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		Style No. Transformer Only	ORDERING DATA		List Price	
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net		Shipping†	Style No. Hanger Iron		Gallons Oil
13200-12540-11880 to 440-220 Volts } (Class 400) 13800-13110-12420 to 460-230 Volts }											
10	ST	638	5-165	29 1/4	16	620	735	379624	109713	18	\$ 569 00‡
15	ST	638	10-165	31 1/4	18	799	955	379625	109714	25	637 00‡
25	ST	638	25-165	42 1/4	24	1150	1380	379626	109715	40	761 00‡
37.5	ST	638	50-23	41 1/4	31 1/4	1679	2000	379627	129384	47	908 00‡
50	ST	638	75-23	46 1/4	37 1/4	1775	2120	379628	129384	55	1046 00‡
75	ST	638	75-23	54	....	2611	3000	379629		68	1294 00‡
100	ST	638	125-23	52 1/4	....	2820	3300	379630		100	1502 00‡
150	ST	638	125-23	62 1/4	....	3850	4400	379631		160	1861 00‡
200	ST	638	125-23	80 1/4	....	4715	5500	379632		228	2150 00‡

22000-20900-19800 to 440-220 Volts } (Class 400) 23000-21850-20700 to 460-230 Volts }											
15	ST	638	15-220	44 1/4	....	1095	1300	379633		35	1094 00‡
25	ST	638	15-220	47 1/4	....	1671	1940	379634		43	1195 00‡
37.5	ST	638	25-220	48	....	1856	2170	379635		58	1311 00‡
50	ST	638	25-220	62	....	2254	2620	379636		72	1411 00‡
75	ST	638	100-220	48 1/4	....	2905	3360	379637		105	1608 00‡
100	ST	638	100-220	60 1/4	....	3385	3900	379638		128	1800 00‡
150	ST	638	100-220	82 1/4	....	4405	5000	379639		190	2147 00‡
200	ST	638	100-220	102 1/4	....	5155	5870	379640		240	2472 00‡

33000-31350-29700 to 440-220 Volts } (Class 400) 34500-32775-31050 to 460-230 Volts }											
37.5	SCT	643	12	88	....	2550	3600	280989		140	1377 00‡
50	SCT	643	11	94	....	3680	4100	280990		260	1475 00‡
75	SCT	643	39	87	....	4050	4200	280991		150	1660 00‡
100	SCT	643	40	95	.....	4560	4780	280992		180	1838 00‡
150	SCT	643	41	102	....	5150	5430	280993		205	2177 00‡
200	SCT	643	42	102	....	7350	7890	280994		300	2479 00‡

NOTE—The high-voltage windings of the above three-phase transformers are connected in star and the low-voltage windings in delta.

SINGLE-PHASE 25-CYCLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		Style No. Transformer Only	ORDERING DATA		List Price	
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net		Shipping†	Style No. Hanger Iron		Gallons Oil
440 to 220-110 Volts } (Class 200) 460 to 230-115 Volts } 480 to 240-120 Volts }											
1 1/2	S	637	3 -23	16 1/4	7	130	150	268457	109712	1 1/2	\$ 86 00
3	S	637	5 -23	17 1/4	7	265	265	268457	109712	3	122 00
5	S	637	7 1/2 -23	21	11	350	350	268458	109712	5	162 00
7.5	S	637	20 -23	22	10	424	496	268459	109713	7	208 00
10	S	637	25 -23	22 1/4	10	503	600	268460	109713	8	250 00
15	S	637	25 -23	30 1/4	19 1/4	689	771	268461	234482	15	328 00‡
25	S	637	37 1/2 -23	37 1/4	23	1011	1094	268462	234482	21	468 00‡
37.5	S	637	75 -23	44	....	1451	1590	268463		54	618 00‡
50	S	637	75 -23	54 1/4	....	1761	1961	268464		75	748 00‡

†Shipping weight includes transformer boxed for shipment, complete with hanger irons (when supplied) and oil in container.

‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus.")

§Hanger irons are not included with this capacity.

Oil weighs approximately 7 pounds net per gallon and 8 1/4 pounds shipping.

NOTE—All of the above single-phase transformers can be operated in bank on three-phase with the high-voltage windings connected in star or in delta.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

SINGLE-PHASE 25-CYCLE TRANSFORMERS—Continued

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS				APPROXIMATE WEIGHT, POUNDS		ORDERING DATA			Gallons Oil	List Price
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	STYLE No. TRANSFORMER ONLY	Style No. Hanger Iron			
		2200 to 220-110 Volts						2200 to 440-220 Volts				
		2300 to 230-115 Volts						2300 to 460-230 Volts				
		2400 to 240-120 Volts						2400 to 480-240 Volts				
								<b>(Class 200)</b>				
											<b>(Class 400)</b>	
1½	S	637	3	-23	16¼	7	130	156	317290	109712	1½	\$ 85 00
3	S	637	5	-23	17¼	7	225	260	251973	267639	3	118 00
5	S	637	7½	-23	21	11	294	350	251974	267640	5	158 00
7.5	S	637	20	-23	22	10	424	500	251975	267641	7	198 00
10	S	637	25	-23	22¼	10	503	565	251976	267642	8	232 00
15	S	637	25	-23	30¼	19½	689	748	251977	267643	15	298 00
25	S	637	37½	-23	37½	23	1011	1103	251979	267644	21	424 00
37.5	SK	637	75	-23	44	.....	1485	1625	251981	316719	55	560 00
50	SK	637	75	-23	54¼	.....	1734	1934	251982	316720	71	682 00
75	SK	639	100	-66	51	.....	3000	3400	268226	267647	97	900 00†
100	SK	639	100	-66	56¼	.....	3496	3946	313216	313217	118	1013 00†
150	SS	643	32	96	.....	.....	4725	5250	267561†	267562	180	1398 00†
200	SS	643	33	86	.....	.....	6000	6650	267563†	267564	194	1675 00†
		4400-2200 to 220-110 Volts						4400-2200 to 440-220 Volts				
		4600-2300 to 230-115 Volts						4600-2300 to 460-230 Volts				
		4800-2400 to 240-120 Volts						4800-2400 to 480-240 Volts				
								<b>(Class 200)</b>				
											<b>(Class 400)</b>	
1½	S	637	5	-23	20¼	7	184	222	379330	109712	4	105 00†
3	S	637	7½	-23	21¼	11	276	336	331403	267663	5	137 00†
5	S	637	20	-23	27¼	16	425	490	331404	267664	11	176 00†
7.5	S	637	25	-23	30¼	19½	622	700	331405	267665	14	218 00†
10	S	637	25	-23	30¼	19½	624	700	331406	267666	14	257 00†
15	S	637	37½	-23	37½	23	912	1000	331407	267667	21	331 00†
25	SK	637	75	-23	44	27¼	1237	1375	267666	267668	59	458 00†
37.5	SK	637	75	-23	54¼	.....	1628	1786	267657	267669	75	616 00†
50	SK	637	75	-23	54¼	.....	1760	1900	267658	267670	75	733 00†
75	SK	639	100	-66	56¼	.....	3176	3600	267659	267671	110	950 00†
100	SK	639	100	-66	56¼	.....	3446	3900	267660	267672	100	1138 00†
150	SS	643	32	96	.....	.....	4725	5250	267555†	267556	180	1454 00†
200	SS	643	33	86	.....	.....	6000	6650	267557†	267558	194	1746 00†
		6600-6300-6000-5700 to 220-110 Volts						6600-6300-6000-5700 to 440-220 Volts				
		6900-6585-6275-5960 to 230-115 Volts						6900-6585-6275-5960 to 460-230 Volts				
		7200-6875-6545-6220 to 240-120 Volts						7200-6875-6545-6220 to 480-240 Volts				
								<b>(Class 200)</b>				
											<b>(Class 400)</b>	
1.5	SK	639	5	-66	23¼	10	279	324	267673	267684	7	130 00†
3	SK	639	7½	-66	25¼	16	420	470	267674	267685	11½	160 00†
5	SK	639	7½	-66	25¼	16	457	507	267675	267686	11	199 00†
7.5	SK	639	15	-66	31	18	652	712	267676	267687	15½	243 00†
10	SK	639	20	-66	32	21	902	1000	267677	267688	22	283 00†
15	SK	639	30	-66	36¼	24	1198	1325	267678	267689	34½	358 00†
25	SK	637	75	-23	44	27¼	1203	1303	267679	267690	54	479 00†
37.5	SK	637	75	-23	54¼	.....	1540	1740	267680	267691	75	623 00†
50	SK	637	75	-23	66	.....	1925	1760	267681	267692	100	743 00†
75	SK	637	100	-66	51	.....	3038	3538	267682	267693	96	980 00†
100	SK	639	100	-66	69¼	.....	3670	4470	379386	379387	152	1154 00†
150	SS	643	32	96	.....	.....	4725	5250	267549†	267550	180	1487 00†
200	SS	643	33	86	.....	.....	6000	6650	267551†	267552	194	1767 00†

†Shipping weight includes transformer boxed for shipment, complete with hanger irons and fuse blocks (when supplied) and oil in container.  
 ‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus").  
 †Hanger irons are not included with this capacity.  
 †Low-voltage winding is arranged for 230-volt two-wire and 230-115-volt three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.  
 Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.  
 NOTE—All of the above single-phase transformers can be operated in bank on three-phase with the high-voltage windings connected in star or in delta.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

SINGLE-PHASE 25-CYCLE TRANSFORMERS—Continued

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS INCLUDING OIL Net Shipping†	ORDERING DATA					List Price										
		Catalogue Page	Dim. Reference	Dim. A		Dim. H	STYLE No. TRANSFORMER ONLY Class 200	Style No. Hanger Iron	Class 400	Style No. Hanger Iron		Gallons Oil									
11000-10450- 9900 to 220-110 Volts } (Class 200)											11000-10450- 9900 to 440-220 Volts } (Class 400)										
11500-10925-10350 to 230-115 Volts } (Class 200)											11500-10925-10350 to 460-230 Volts } (Class 400)										
2.5	SK	639	5-110	27 1/4	16	430	490	307034	307042	109713	11 1/2	\$184 00									
5	SK	639	15-110	32 1/4	18	670	775	307035	307043	109714	18	232 00									
10	SK	639	20- 66	32	21	915	1020	307036	307044	109715	24	333 00									
15	SK	637	75- 23	44	27 1/4	1180	1320	307037	307045	129384	54	421 00									
25	SK	637	75- 23	54 1/4	37	1550	1700	307038	307046	129384	71	567 00									
37.5	SK	637	75- 23	66	....	2000	2200	287700	287709		95	715 00									
50	SK	637	75- 23	66	....	2060	2260	307039	307047		94	670 00									
75	SK	639	100- 66	56 1/4	....	3290	3700	307040	307048		103	1113 00									
100	SK	639	100- 66	69 1/4	....	3840	4470	307041	307049		143	1312 00									
150	SS	643	32	97	....	4925	5400	287543†	287544		170	1667 00									
200	SS	643	34	97	....	6600	7250	287545†	287546		235	2000 00									
13200-12540-11880 to 220-110 Volts } (Class 200)											13200-12540-11880 to 440-220 Volts } (Class 400)										
13800-13110-12420 to 230-115 Volts } (Class 200)											13800-13110-12420 to 460-230 Volts } (Class 400)										
2.5	SK	639	5-110	27 1/4	16	466	520	307050	307058	109713	11 1/2	215 00									
5	SK	639	15-110	32 1/4	18	653	760	307051	307059	109714	18	269 00									
10	SK	639	30- 66	36 1/4	24	1088	1215	307052	307060	109715	34	372 00									
15	SK	637	75- 23	44	27 1/4	1138	1275	307053	307061	129384	59	460 00									
25	SK	637	75- 23	54 1/4	37	1172	1330	307054	307062	129384	75	604 00									
37.5	SK	637	75- 23	54 1/4	....	1825	2025	287718	287727		75	760 00									
50	SK	637	75- 23	66	....	2150	2350	307055	307063		100	891 00									
75	SK	639	100- 66	56 1/4	....	3392	3700	307056	307064		106	1126 00									
100	SK	639	100- 66	69 1/4	....	3840	4470	307057	307065		143	1329 00									
150	SS	643	33	87	....	5850	6450	287737†	287738		185	1687 00									
200	SS	643	34	97	....	6750	7500	287739†	287740		230	2033 00									
22000-20900-19800 to 220-110 Volts } (Class 200)											22000-20900-19800 to 440-220 Volts } (Class 400)										
23000-21850-20700 to 230-115 Volts } (Class 200)											23000-21850-20700 to 460-230 Volts } (Class 400)										
5	SK	640	10 -220	39 1/4	....	866	1057	307066	307074	.....	26	510 00									
10	SK	640	25 -220	42 1/2	....	1348	1723	307067	307075	.....	39	597 00									
15	SK	640	37 1/2-220	47 1/2	....	1757	2040	307068	307076	.....	51	686 00									
25	SK	640	50 -220	50	....	2077	2445	307069	307077	.....	59 1/2	812 00									
37.5	SK	640	75 -220	56 1/4	....	2665	3100	307070	307078	.....	90	960 00									
50	SK	640	75 -220	64	....	2800	3670	307071	307079	.....	108	1092 00									
75	SK	640	125 -220	55	....	3782	4500	307072	307080		135	1313 00									
100	SK	640	125 -220	63	....	4357	5122	307073	307081		150	1512 00									
150	SC	643	36	84	....	6300	7050	287749†	287750		220	1917 00									
200	SC	643	37	92	....	7340	8200	287751†	287752		245	2267 00									
33000-31350-29700 to 220-110 Volts } (Class 200)											33000-31350-29700 to 440-220 Volts } (Class 400)										
34500-32775-31050 to 230-115 Volts } (Class 200)											34500-32775-31050 to 460-230 Volts } (Class 400)										
10	SC	643	2	76	....	1260	1390	287509	287510		47	688 00									
15	SC	643	3	76	....	1580	1850	287511	287512		72	783 00									
25	SC	643	6	82	....	2320	2340	287513	287514		115	902 00									
37.5	SC	643	8	94	....	2900	3225	287515	287516		150	1054 00									
50	SC	643	9	100	....	3250	3600	287517	287518		165	1183 00									
75	SC	643	25	92	....	4350	4750	287519	287520		160	1421 00									
100	SC	643	26	98	....	4700	5250	287521	287522		170	1658 00									
150	SC	643	37	100	....	6900	7675	287525†	287526		250	2025 00									
200	SC	643	38	110	....	8000	8800	287527†	287528		290	2363 00									

†Shipping weight includes transformer boxed for shipment, complete with hanger irons (when supplied) and oil in container.  
 †Hanger irons are not included with this capacity.  
 †Low-voltage winding is arranged for 230-volt two-wire and 230-115-volt three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.  
 Oil weighs approximately 7 pounds net per gallon and 8 1/2 pounds shipping.  
 NOTE—The above transformers are suitable for delta connection, but are not suitable for star-connection on the high-voltage side when banked for three-phase operation.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

THREE-PHASE 25-CYCLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		STYLE No.		ORDERING DATA		List Price	
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	TRANSFORMER ONLY** A (Star)	B (Delta)	Style No. Hanger Iron		Gallons Oil
2200-3810Y to 440-220 Volts 2300-3984Y to 460-230 Volts 2400-4157Y to 480-240 Volts												
										(Class 400)		
5	ST	638	7½-40	24¾	16	520	620	267816	307093	109713	10	\$ 266 00
7.5	ST	638	15-40	28¾	16	630	740	267817	307094	109713	13½	324 00
10	ST	638	25-40	31¾	23¾	893	1055	267818	307095	234482	22½	374 00
15	ST	638	37½-40	39¾	29¾	1103	1305	267819	307096	129384	29	467 00
25	ST	638	75-23	40¾	31¾	2414	2800	267820	307097	129384	62	629 00
37.5	ST	638	75-23	40¾	....	2414	2800	267821	307098	129384	62	797 00
50	ST	638	75-23	57¾	....	2855	3400	267822	307099	199217	100	958 00
75	ST	638	125-23	58¾	....	3695	4270	267823	307100	1	144	1272 00†
100	ST	638	125-23	68¾	....	4230	4900	267824	307101	1	175	1544 00†

SINGLE-PHASE 60-CYCLE MANHOLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		STYLE No.		ORDERING DATA		List Price	
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	TRANSFORMER ONLY Class 200	Class 400	Gallons Oil		
2200 to 220-110 Volts 2300 to 230-115 Volts 2400 to 240-120 Volts												
						(Class 200)						
2200 to 440-220 Volts 2300 to 460-230 Volts 2400 to 480-240 Volts												
						(Class 400)						
5	SM	641	5-23	22¾	....	303	358	247122	364894		5	\$ 168 00†
7.5	SM	641	7½-23	24¾	....	414	474	247123	364895		7	208 00†
10	SM	641	10-23	28¾	....	520	580	247124	364896		10	245 00†
15	SM	641	10-23	28¾	....	676	760	247125	364897		11½	309 00†
25	SM	641	25-23	40¾	....	1098	1185	379493	364898		21½	427 00†
37.5	SM	641	40-23	42¾	....	1566	1700	280026	364899		26½	550 00†
50	SM	641	40-23	59	....	1927	1950	379494	364900		46	649 00†
75	SM	641	75-23	50¾	....	2155	2150	191395	191396		58	818 00†
100	SM	641	75-23	61	....	2442	2605	191397	191398		76	948 00†
150	SKM	641	150-23	57¾	....	3415	4200	249303†	267575		145	1180 00†
200	SKM	641	150-23	74¾	....	3820	4600	249304†	267576		180	1370 00†

NOTE—All of the above single-phase transformers can be operated in bank on three-phase operation with the high-voltage windings in star or in delta.

THREE-PHASE 60-CYCLE MANHOLE TRANSFORMERS

FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW

Capacity Kv.-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		STYLE No.		ORDERING DATA		List Price
		Catalogue Page	Dim. Reference	Dim. A	Dim. H	INCLUDING OIL Net	Shipping†	TRANSFORMER ONLY** A (Star)	B (Delta)	Gallons Oil	
2200-3810Y to 440-220 Volts 2300-3984Y to 460-230 Volts 2400-4157Y to 480-240 Volts											
										(Class 400)	
5	STM	642	5-23	26¾	....	390	440	267577	307102	8½	\$ 288 00†
7½	STM	642	7½-23	28	....	468	528	267578	307103	9	333 00†
10	STM	642	10-23	28¾	....	582	647	267579	307104	12	378 00†
15	STM	642	15-23	32¾	....	665	735	267580	307105	15½	450 00†
25	STM	642	25-23	39¾	....	1096	1176	267581	307106	26½	595 00†
37½	STM	642	40-23	45	....	1647	1737	267582	307107	40	755 00†
50	STM	642	50-23	47¾	....	2161	2261	267583	307108	58	900 00†
75	STM	642	75-23	49	....	2339	2490	267584	307109	52	1150 00†
100	STM	642	75-23	57¾	....	2604	2830	267585	307110	64	1390 00†

†Shipping weight includes transformer boxed for shipment, complete with hanger irons and fuse blocks (when supplied) and oil in container.  
 ‡Fuse blocks are not included in this price (see pages on "Auxiliary Apparatus").  
 †Hanger irons are not included with this capacity.  
 †Low-voltage winding is arranged for 230-volt two-wire and 230-115-volt three-wire operation, but the low-voltage windings cannot be connected in parallel for 115 volts.  
 \*\*Style numbers in Column A have the high-voltage windings connected in star for 3984 volts.  
 †Style numbers in column B have the high-voltage windings connected in delta for 2300 volts.  
 Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.

Order by Style Number

DISTRIBUTION TRANSFORMERS—Continued

OUTLINE DIMENSIONS

Steel-Clad Type S Transformers

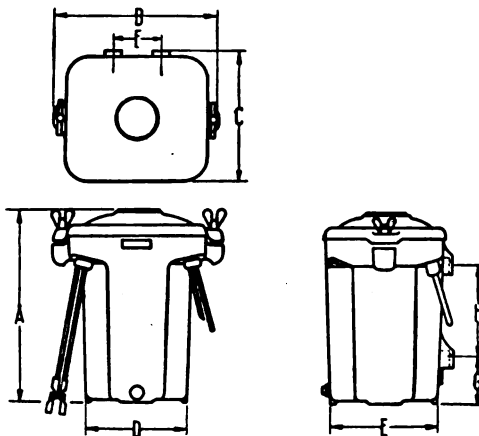


FIG. 1

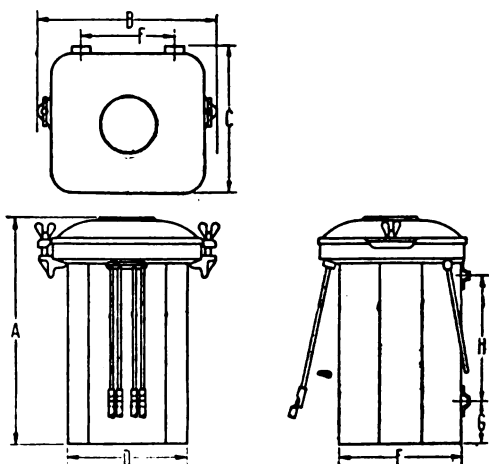


FIG. 2

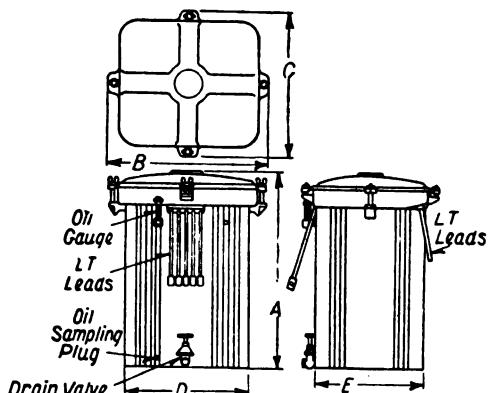


FIG. 3

Dimension Reference	Dimension Fig.	A <sup>a</sup>	B	C	DIMENSIONS IN INCHES				H <sup>b</sup>
					D	E	F		
1 -23C	1	...	14 3/4	9 5/8	8 3/4	8 3/4	2 3/4	...	
1 1/2 -23	1	...	16 1/2	11 1/2	9 1/2	9 1/2	3 1/2	...	
2 -23C	1	...	15 3/4	12	10 1/2	10 1/2	3 1/2	...	
3 -23C	1	...	15 3/4	12	10 5/8	10 5/8	3 1/2	...	
3 -23	1	...	16 1/4	12 1/2	10 1/2	10 1/2	3 1/2	...	
5 -23	1	...	18	13 3/4	11 1/2	11 1/2	3 1/2	...	
7 1/2 -23	1	...	19 5/8	15 1/4	13 1/2	13 1/2	3 1/2	...	
20 -23	2	...	22 1/2	20	15 3/4	15 3/4	7 1/2	...	
25 -23	2	...	24 1/2	21 3/4	16 3/4	16 3/4	8	...	
37 1/2 -23	2	...	28 1/2	23 3/4	18 3/4	18 3/4	10	...	
75 -23	2	...	35 1/2	27 3/4	27 3/4	20 3/4	13	...	
150 -23	3	...	43 3/8	36 3/4	35	28 3/8	...	...	

<sup>a</sup>Dimensions A and H are listed opposite the transformer style number in tables on pages 628 to 636 inclusive.  
<sup>b</sup>C—Cast-iron tanks.  
 These dimensions are for reference only. For official dimensions apply to nearest district office.

DISTRIBUTION TRANSFORMERS—Continued

Type ST Three-Phase Transformers

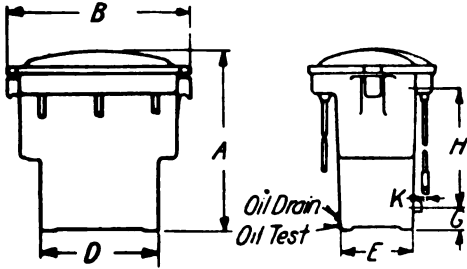
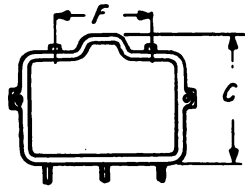


FIG. 1

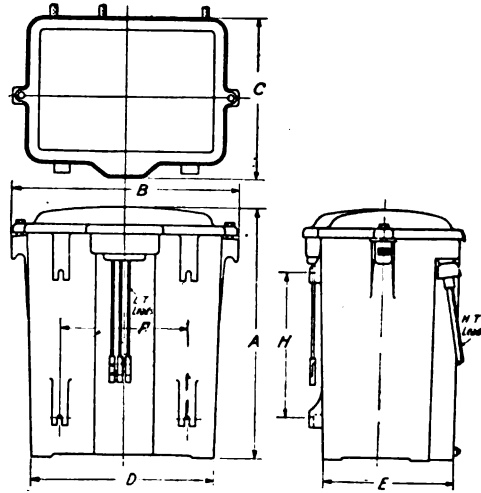


FIG. 2

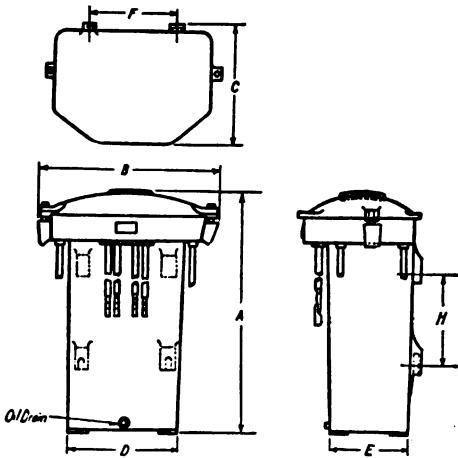


FIG. 3

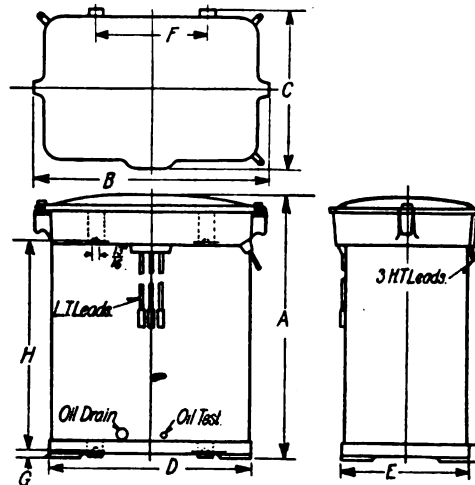


FIG. 4

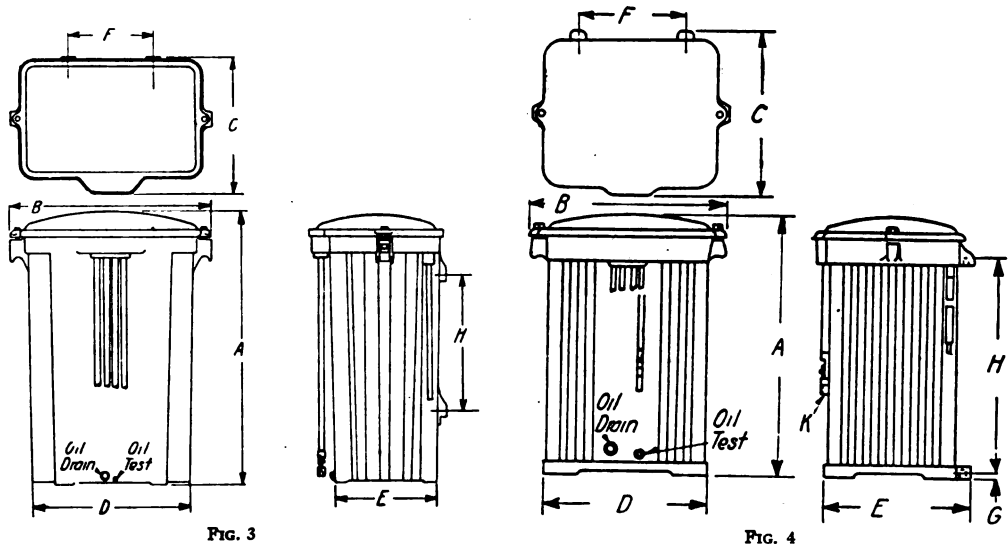
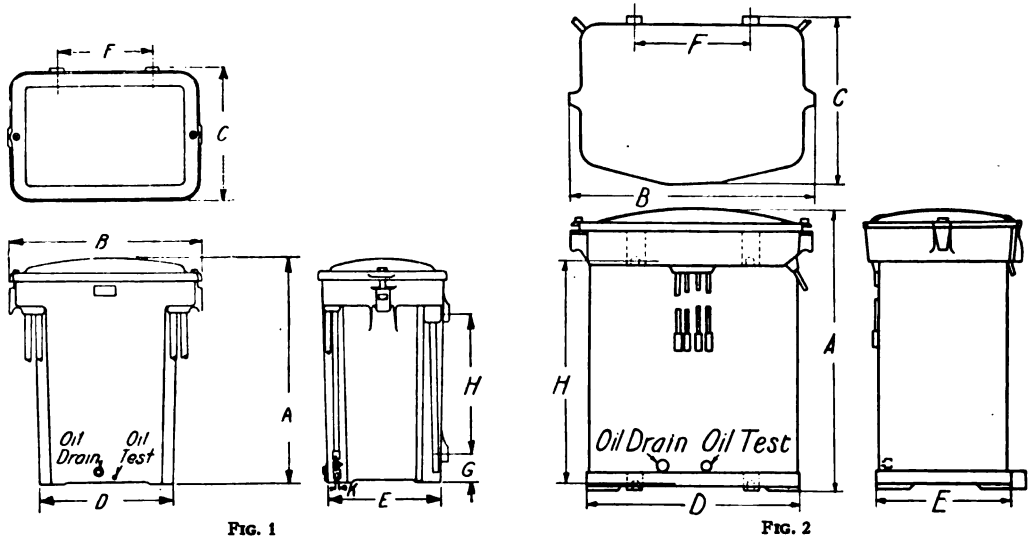
Dimension Reference	Dimension Fig.	A*	B	C	DIMENSIONS IN INCHES				H*
			D	E	F				
3 - 23	1	.....	20 7/8	14 3/4	13 3/8	8 1/4	10	.....	
5 - 40	3	.....	25 1/2	15	15 5/8	10 5/8	11	.....	
7 1/2 - 40	3	.....	27 1/2	16 3/8	17 3/4	11	11 1/2	.....	
15 - 40	3	.....	29 1/4	17 1/8	19 1/4	11 3/4	12	.....	
5 - 165	2	.....	28 3/4	19 5/8	23	12 3/4	18	.....	
10 - 165	2	.....	29 3/4	21 5/8	24 3/8	16 1/2	16	.....	
15 - 165	2	.....	29 3/4	21 5/8	24 3/8	16 1/2	16	.....	
25 - 165	2	.....	29 3/4	21 5/8	24 3/8	16 1/2	16	.....	
25 - 40	4	.....	32 3/8	22 3/4	27 1/2	21 3/8	16	.....	
37 1/2 - 40	4	.....	35 3/8	26 1/4	29 3/8	23 3/8	16	.....	
15 - 220	4	.....	35 3/8	25 5/8	29 3/8	20 1/4	16	.....	
25 - 220	4	.....	40 3/4	28 3/8	34	23 3/8	18	.....	
50 -	4	.....	40 3/4	28 3/8	34	23 3/8	18	.....	
75 - 23	4	.....	45	29 3/8	38 3/8	24 3/8	21	.....	
125 - 23	4	.....	51 1/4	32 3/4	45 3/8	27 3/8	28	.....	
100 - 220	4	.....	51 1/4	32 3/4	45 3/8	30 3/8	28	.....	

\*Dimensions A and H are listed opposite the transformer style number in the tables on pages 628 to 636 inclusive. These dimensions are for reference only. For official dimensions apply to nearest district office.



DISTRIBUTION TRANSFORMERS—Continued

Type SK Single-Phase Transformers  
Low Voltage



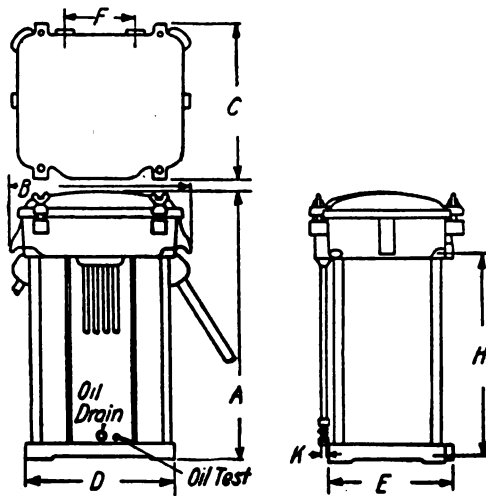
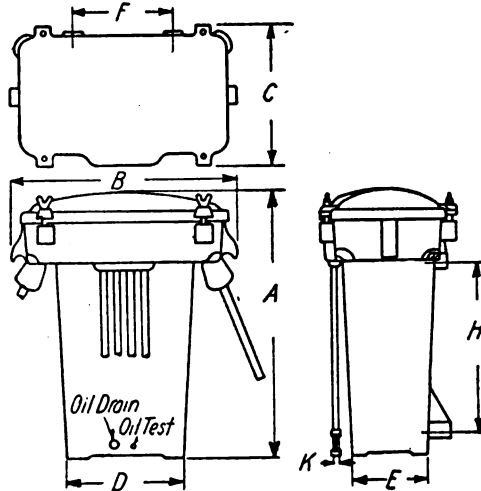
Dimension Reference	Dimension Fig.	DIMENSIONS IN INCHES							
		A*	B	C	D	E	F	H*	
1 - 66	1	.....	16 1/2	11 5/8	10 5/8	9 3/8	6 1/2	.....	
1 - 110	1	.....	21 1/2	11 5/8	10 5/8	9 3/8	7 1/2	.....	
2 - 66	1	.....	18 3/8	12 1/8	12 1/8	9 3/8	8 1/2	.....	
5 - 66	1	.....	19 3/8	13	14 1/2	10 3/8	9	.....	
7 1/2 - 66	1	.....	22 3/8	15 1/4	15 3/4	12 3/8	11	.....	
2 1/2 - 110	1	.....	22	13 1/2	12	10 3/8	9	.....	
5 - 110	1	.....	24 1/2	15 1/4	15 3/4	12 3/8	11	.....	
15 - 66	1	.....	24 5/8	17	17 1/2	14 1/4	11	.....	
15 - 110	1	.....	25 1/2	17	17 1/2	14 1/4	11	.....	
20 - 66	3	.....	30 3/4	21 5/8	24 3/8	15 3/4	12	.....	
25 - 66	3	.....	30 3/4	21 5/8	24	15 3/4	12	.....	
30 - 66	3	.....	33	22 3/4	26 3/4	17 3/8	15	.....	
37 1/2 - 66	3	.....	33	22 3/4	26 1/2	17 1/4	15	.....	
37 1/2 - 69	2	.....	32 3/4	27	25 3/8	20 3/8	16	.....	
50 - 66	3	.....	35 1/2	24 1/2	28 3/8	18 3/8	15	.....	
75 - 66	4	.....	37 1/2	30 5/8	31 1/2	28 3/8	17	.....	
100 - 66	4	.....	40 1/2	34 1/2	34 5/8	30 3/8	17	.....	

\*Dimensions A and H are listed opposite the transformer style number in the tables on pages 628 to 636 inclusive.  
 †Not equipped with hanger-iron lugs as transformer is for platform mounting.  
 These dimensions are for reference only. For official dimensions apply to nearest district office.

DISTRIBUTION TRANSFORMERS—Continued

Type SK Single-Phase Transformers

High Voltage



Dimension Reference	Dimension Fig.	A*	B	C	DIMENSIONS IN INCHES				H*
					D	E	F		
5 -220	1	....	29 <sup>3</sup> / <sub>8</sub>	21	14 <sup>5</sup> / <sub>8</sub>	13 <sup>7</sup> / <sub>8</sub>	7 <sup>1</sup> / <sub>2</sub>	....	
10 -220	1	....	33 <sup>3</sup> / <sub>8</sub>	23 <sup>3</sup> / <sub>8</sub>	18 <sup>1</sup> / <sub>2</sub>	16 <sup>5</sup> / <sub>8</sub>	9 <sup>1</sup> / <sub>2</sub>	....	
15 -220	1	....	34	25 <sup>3</sup> / <sub>8</sub>	18 <sup>3</sup> / <sub>8</sub>	17 <sup>3</sup> / <sub>8</sub>	10	....	
25 -220	1	....	35	27 <sup>3</sup> / <sub>8</sub>	25 <sup>3</sup> / <sub>8</sub>	18 <sup>3</sup> / <sub>8</sub>	15	....	
37 <sup>1</sup> / <sub>2</sub> -220	1	....	36 <sup>1</sup> / <sub>2</sub>	28 <sup>3</sup> / <sub>8</sub>	28 <sup>1</sup> / <sub>2</sub>	19 <sup>3</sup> / <sub>8</sub>	16	....	
50 -220	2	....	34 <sup>1</sup> / <sub>2</sub>	31 <sup>1</sup> / <sub>2</sub>	30 <sup>1</sup> / <sub>2</sub>	28 <sup>3</sup> / <sub>8</sub>	16	....	
75 -220	2	....	36 <sup>1</sup> / <sub>2</sub>	35 <sup>3</sup> / <sub>8</sub>	31 <sup>3</sup> / <sub>8</sub>	31 <sup>3</sup> / <sub>8</sub>	17	....	
125 -220	2	....	44	40 <sup>1</sup> / <sub>2</sub>	39	35 <sup>1</sup> / <sub>2</sub>	†	....	

\*Dimensions A and H are listed opposite the transformer style number in the tables on pages 628 to 636 inclusive.

†Not equipped with hanger-iron lugs as transformer is for platform mounting.

These dimensions are for reference only. For official dimensions apply to nearest district office.

DISTRIBUTION TRANSFORMERS—Continued

Type SM Single-Phase Manhole Transformers

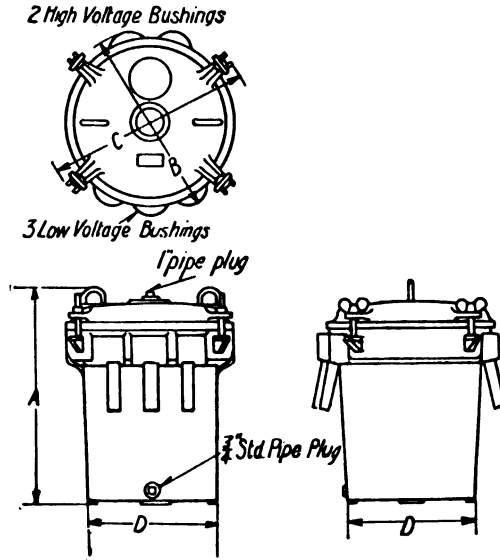


FIG. 1

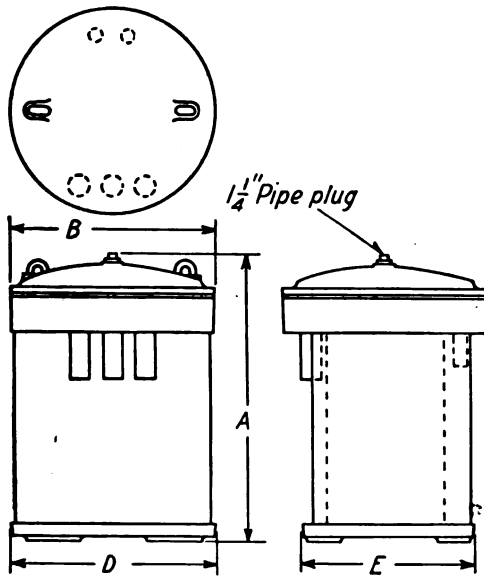


FIG. 2

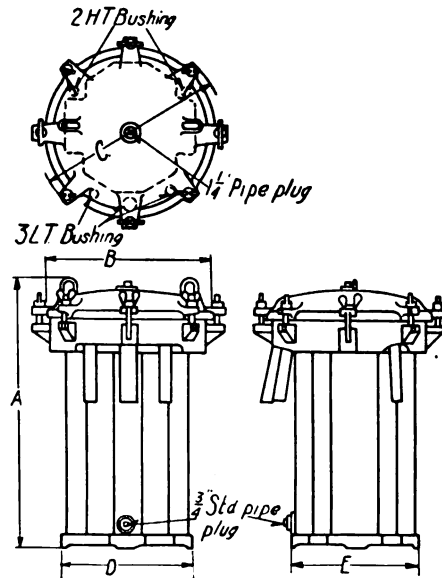


FIG. 3

Dimension Reference	Dimension Fig.	DIMENSIONS IN INCHES				
		A*	B	C	D	E
5 -23	1	.....	19 <sup>7</sup> / <sub>8</sub>	19 <sup>7</sup> / <sub>8</sub>	12 <sup>3</sup> / <sub>4</sub>	.....
7 <sup>1</sup> / <sub>2</sub> -23	1	.....	20 <sup>1</sup> / <sub>2</sub>	21 <sup>1</sup> / <sub>4</sub>	14	.....
10 -23	1	.....	22 <sup>3</sup> / <sub>8</sub>	22 <sup>5</sup> / <sub>8</sub>	14 <sup>5</sup> / <sub>8</sub>	.....
15 -23	3	.....	23 <sup>3</sup> / <sub>8</sub>	26 <sup>3</sup> / <sub>4</sub>	18 <sup>1</sup> / <sub>2</sub>	18
25 -23	3	.....	25 <sup>1</sup> / <sub>8</sub>	27 <sup>3</sup> / <sub>4</sub>	19 <sup>1</sup> / <sub>2</sub>	19 <sup>1</sup> / <sub>4</sub>
40 -23	3	.....	26 <sup>7</sup> / <sub>8</sub>	29 <sup>1</sup> / <sub>2</sub>	21 <sup>5</sup> / <sub>8</sub>	21 <sup>1</sup> / <sub>2</sub>
75 -23	2	.....	31 <sup>1</sup> / <sub>4</sub>	.....	31 <sup>1</sup> / <sub>4</sub>	25 <sup>5</sup> / <sub>8</sub>
150 -23	2	.....	39 <sup>1</sup> / <sub>4</sub>	.....	39 <sup>1</sup> / <sub>4</sub>	34 <sup>1</sup> / <sub>4</sub>

\*Dimension A is listed opposite the transformer style number in the tables on pages 628 to 636 inclusive. These dimensions are for reference only. For official dimensions apply to nearest district office.

DISTRIBUTION TRANSFORMERS—Continued

Type STM Three-Phase Manhole Transformers

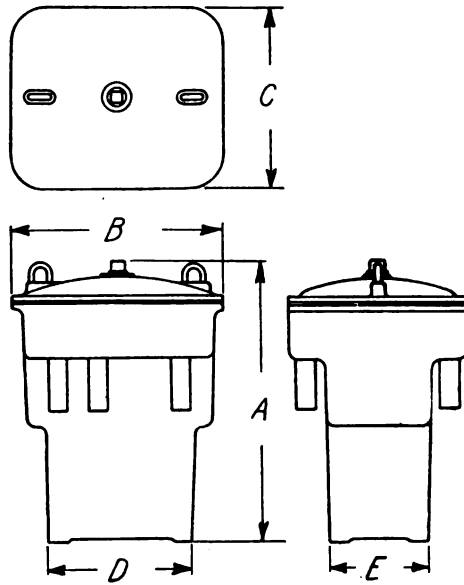


FIG. 1

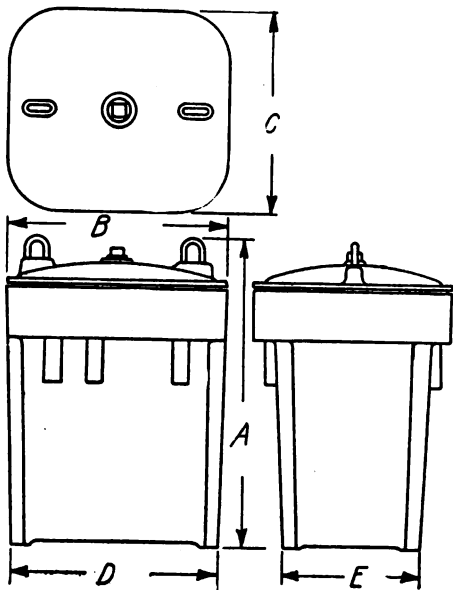


FIG. 2

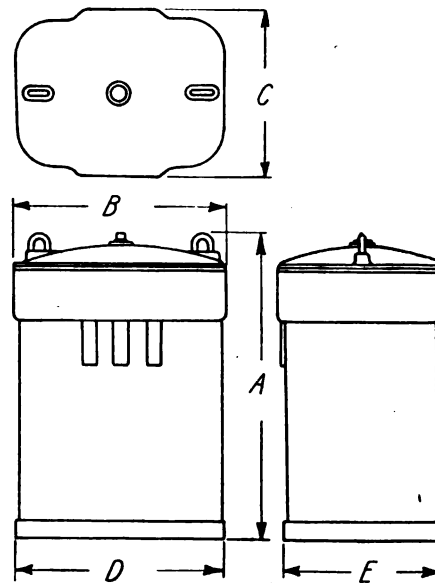


FIG. 3

DIMENSIONS IN INCHES							
Dimension Reference	Dimension Fig.	A*	B	C	D	E	Diagonal† Dimension
5 -23	1	.....	20 3/4	17 3/4	14 3/4	7 9/4	24 1/4
7 1/2 -23	1	.....	21 3/4	18 3/4	15 3/4	10 1/2	25 1/4
10 -23	1	.....	23 3/4	20 3/4	16 3/4	11 1/4	24 1/2
15 -23	2	.....	23 3/4	21 1/4	20	11 3/4	27 1/4
20 -23	2	.....	27 3/4	21 1/2	26	15 3/4	28 1/4
25 -23	2	.....	27 3/4	21 1/2	25 3/4	15 3/4	30 1/2
40 -23	2	.....	31 1/4	23 1/2	29 1/2	16 3/4	34 1/2
50 -23	2	.....	34	25	32 1/4	19 1/4	35 1/2
75 -23	3	.....	33 3/4	26 1/2	33 3/8	23 1/4	36
125 -23	3	.....	42 3/4	28	42 3/8	25 1/4	44 1/2

\*Dimension A is listed opposite the transformer style number in the tables on pages 628 to 636 inclusive.  
 †Diagonal dimension is maximum dimension across transformer for manhole clearance.  
 These dimensions are for reference only. For official dimensions apply to nearest district office.

DISTRIBUTION TRANSFORMERS—Continued

Types SC, SS and SCT Single and Three-Phase† Transformers

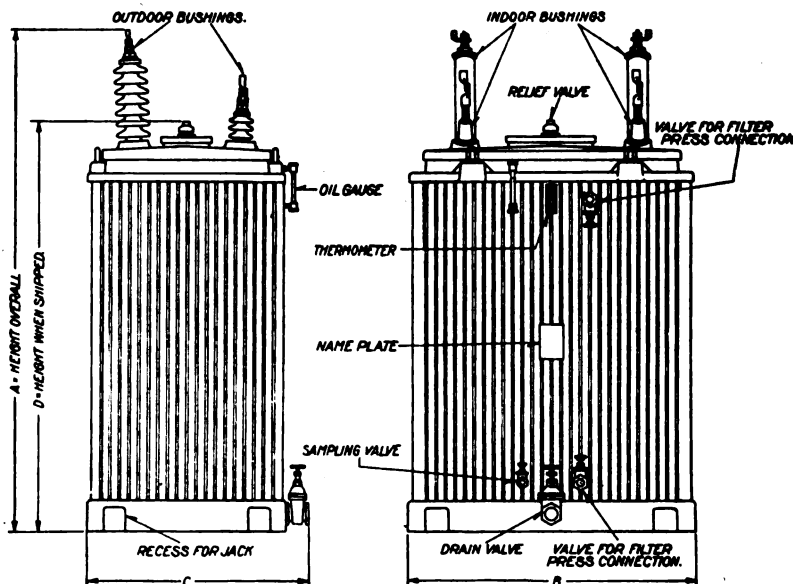
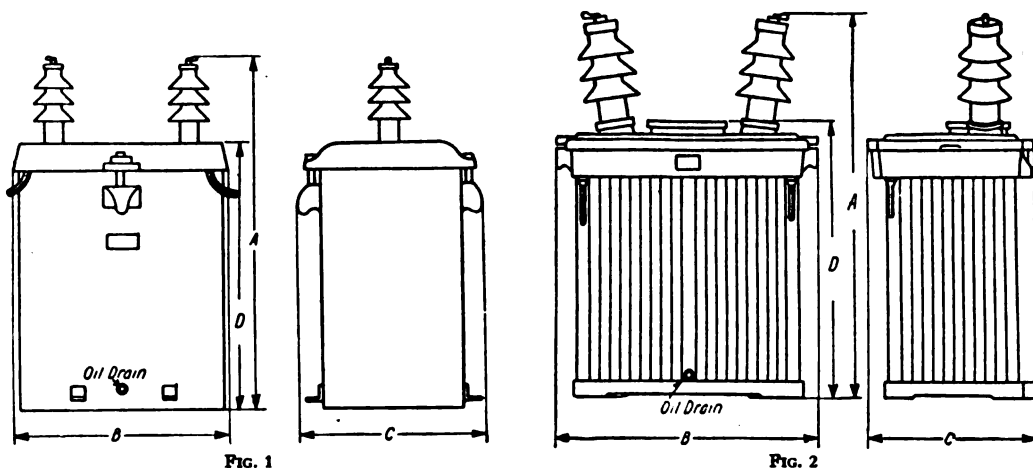


FIG. 3

Dimen. Ref.	Dimen. Fig.	DIMENSIONS IN INCHES				Dimen. Ref.	Dimen. Fig.	DIMENSIONS IN INCHES			
		A*	B	C	D			A*	B	C	D
1	1	....	28	23	42	26	2	....	52	33	70
2	1	....	28	23	48	27	2	....	52	35	70
3	1	....	32	26	48	31	3	....	33	37	71
4	1	....	32	26	54	32	3	....	33	37	81
5	1	....	32	26	60	33	3	....	39	44	72
6	1	....	39	30	54	34	3	....	39	44	82
7	1	....	39	30	60	35	3	....	39	44	93
8	1	....	39	30	66	36	3	....	51	42	64
9	1	....	39	30	72	37	3	....	51	42	72
10	1	....	56	30	60	38	3	....	51	42	82
11	1	....	56	30	65	39	3	....	51	34	58
12	1	....	46	24	53	40	3	....	51	34	66
13	1	....	39	33	42	41	3	....	51	34	73
14	1	....	39	33	48	42	3	....	60	40	72
15	1	....	39	33	60	43	3	....	43	48	99
16	1	....	39	33	66	44	3	....	43	48	114
17	1	....	52	35	64	45	3	....	58	46	71
18	1	....	48	37	70	46	3	....	58	46	82
19	1	....	39	33	78	47	3	....	58	46	93
24	2	....	52	33	54	48	3	....	49	54	114
25	2	....	52	33	64	49	3	....	56	63	111

\*Dimension A is listed opposite the transformer style number in the tables on pages 628 to 636 inclusive, and 648 to 652 inclusive.

†There will be three high-voltage and three low-voltage bushings on three-phase transformers. However the outline dimensions will be the same as shown.

These dimensions are for reference only. For official dimensions apply to the nearest district office.

DISTRIBUTING TRANSFORMERS—Continued

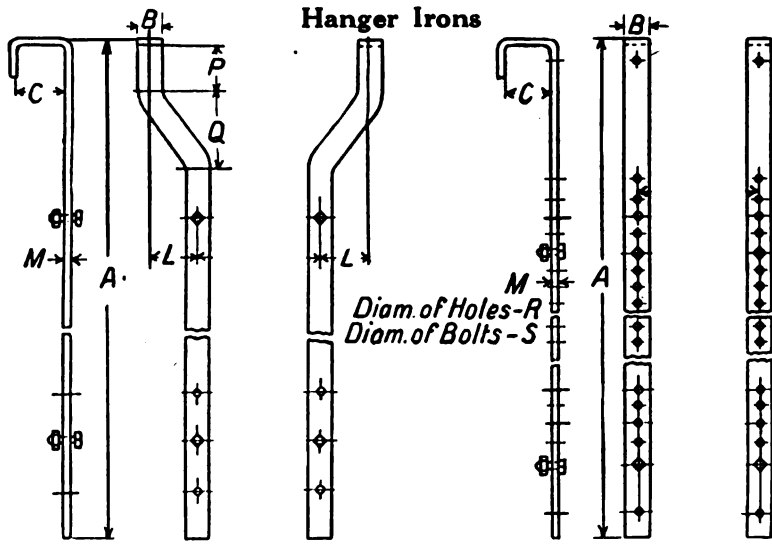


FIG. 1

FIG. 2

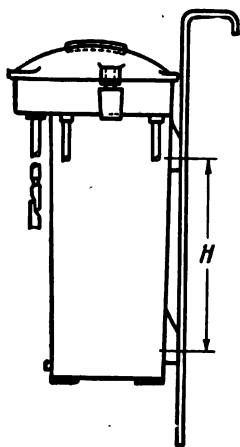


FIG. 3

Style No.	Fig.	DIMENSIONS IN INCHES CORRESPONDING TO LETTERS IN OUTLINE DRAWINGS										Approx. Net Wt. Per Pair, Pounds	Approx. Shipping Weight Per Pair, Pounds	Dimension H* Fig. 3 Figures below give distance in inches between holes provided to mount transformers on hanger irons.
		A	B	C	L	M	P	Q	R	S				
109712	1	28 1/4	1 3/8	4	5 3/4	1/2	1	7	1/2	3/8	6	8	7-11	
109713	1	33 3/8	1 3/8	4	4 1/2	3/8	1	7	1/2	1/2	15	20	7-10-11-16	
109714	1	43 1/2	2 1/4	4	4 1/2	1/2	1	7	1/2	3/4	34	34	18-21	
109715	1	54 1/4	2 1/4	4	4 1/2	3/4	1	7	1/2	3/4	60	60	24-36	
109733	1	43 3/8	1 3/8	4	4 1/2	3/8	1	7	1/2	1/2	19	23	16	
234482	1	43 3/8	2 1/4	4	4 1/2	1/2	1	7	1/2	1/2	30	35	19 1/2-23-27 43 1/2-44 1/2-45 1/2 46 1/2-48-49 1/2 50 1/2-51 1/2	
199217	2	64	3"	4	...	3/4	...	...	1/2	1/2	81	81	23 1/2-23 1/2-23 1/2 24-25 1/2-26 1/2 27 1/2-28 1/2-28 1/2 28 1/2-29 1/2-30 1/2 31 1/2-31 1/2-32 32 1/2-33 1/2-34 1/2 35 1/2-36 1/2-37- 39 1/2-40 1/2-44 1/2	
129384	2	58	3	4	...	3/4	...	...	1/2	1/2	82	82		

\*Note that on account of the number of holes provided, the same style hanger irons can be used in many cases to mount different size transformers.  
The dimensions on this page are for reference only. For official dimensions apply to nearest district office.

## STANDARDIZATION OF DISTRIBUTION TRANSFORMERS

During the past several years the subject of Transformer Standardization has received considerable attention from the American Institute of Electrical Engineers, the National Electric Light Association and the Electric Power Club. The work of the American Institute of Electrical Engineers has been devoted to the formation of rules covering methods of rating and testing while the National Electric Light Association and the Electric Power Club have directed their efforts to the standardization of commercial capacity, voltage, and frequency ratings.

The most important rules from an operating standpoint established as a result of the standardization work of the American Institute may be summarized by the statements that the maximum tem-

perature rise of a transformer, under continuous full-load operation should not exceed 55° C above an ambient or air temperature of 40° C and that the copper loss should be measured by a wattmeter and the result corrected to a temperature of 75° C.

The most important results of the standardization work of the National Electric Light Association and the Electric Power Club, in so far as it covers distribution transformers, are summarized in the following tabulations for single-phase and three-phase transformers. The tabulation for single-phase transformers is divided into two parts, one including transformers for supplying service voltages 600 volts and below, the other including transformers for supplying distribution voltages above 600 volts.

STANDARDIZATION OF DISTRIBUTION TRANSFORMERS—Continued

STANDARD TYPES, FREQUENCIES, SIZES AND VOLTAGE RATINGS OF DISTRIBUTION TRANSFORMERS

Single-Phase, Sizes 200 Kv-a. and Below for Supplying Miscellaneous Lighting and Power Service

Standard Types: Oil-immersed, self-cooled, 25 cycles per second. Standard Sizes in kv-a. continuous ratings at 55° C. rise for single-phase transformers { 1.5, 2.5, 3, 5, 7.5, 10, 15, 25, 37.5, 50, 75, 100, 150 and 200.

Standard Size Limits, Voltage Ratings and Taps of Single-Phase Transformers

NOTE—See following Table for sizes that are standard for the various voltage classes.

Standard Line Voltages	Standard Sizes in Kv-a. Continuous Ratings for Each Voltage Class	STANDARD VOLTAGE RATINGS AND TAPS OF SINGLE-PHASE TRANSFORMERS FOR SUPPLYING SERVICE VOLTAGES 600 AND BELOW		STANDARD VOLTAGE RATINGS AND TAPS OF SINGLE-PHASE TRANSFORMERS FOR SUPPLYING DISTRIBUTION VOLTAGES ABOVE 600	
		Transformer High-Voltage Ratings for Operation from Various Standard Line Voltages	On Full Winding	Transformer Low-Voltage Ratings for Supplying Service Voltages 600 and Below	Transformer High Voltage Ratings for Operation from Various Standard Line Voltages
440	1.5-3 to 100 incl.	440	220-440	...to 220-110	6600-11430Y
		460	230-460	...to 230-115	6270
		480	240-480	...to 240-120	5940
550	1.5-3 to 100 incl.	550	220-550	...to 220-110	11000
		575	230-575	...to 230-115	10450
		600	240-600	...to 240-120	9900
2300	1.5-3 to 200 incl.	2200	220-2200	...or to 440-220	13200
		2300	230-2300	...or to 460-230	12540
		2400	240-2400	...or to 480-240	11880
4600	1.5-3 to 200 incl.	2200-4400	220-110	...to 220-110	22000
		2300-4600	230-115	...to 230-115	20900
		2400-4800	240-120	...to 240-120	19800
6600	1.5-3 to 200 incl.	6600-11430Y	5700	...or to 440-220	33000
		6900-11950Y	6000	...or to 460-230	31350
		7200-12470Y	6275	...or to 480-240	29700
11000	2.5-5-10 to 200 incl.	11000	6300	...or to 440-220	6600-11430Y
		13200	6586	...or to 460-230	6270
		13600	6875	...or to 480-240	5940
13200	2.5-5-10 to 200 incl.	11500	10450	...or to 440-220	11000
		12540	10925	...or to 460-230	10450
		13110	13110	...or to 480-240	9900
22000	5-10 to 200 incl.	22000	19800	...or to 440-220	13200
		23000	20700	...or to 460-230	12540
		33000	31350	...or to 480-240	11880
33000	10 to 200 incl.	33000	32775	...or to 440-220	22000
		34500	34500	...or to 460-230	20900
				...or to 480-240	19800

Standard single-phase distribution transformers for supplying nominal 2300 or 4000-volt distribution and line voltage ratings listed above, will be designed for successful operation when excited on full winding at 5 per cent above their rated voltage. Transformers having voltage ratings of 6600-11430Y to 2300, are when operated in bank, suitable for transforming from 6600 to 2300; from 6600 to 4000Y or from 11430Y to 2300. They should not be used simultaneously to transform from 11430Y to 4000 Y as this connection may result in the presence of excessive stresses in the windings due to harmonic voltages.

Transformers having low-voltage rating of 230-115 for sizes 100 kv-a. and below are arranged for series, multiple or three-wire service by connection of the low-voltage leads outside the transformer tank; whereas sizes 125, 150 and 200 kv-a. are suitable for series or three-wire service only. Transformers having low-voltage rating of 400-230 for sizes 200 kv-a. and below, are suitable for series or multiple service only. These odd taps for distribution transformers of the 6600-volt class are chosen because of present established practice.

NOTE—Voltage ratings in bold type will be considered the normal voltage ratings of those lines and guarantees will be made only on these normal voltage ratings. It is understood, however, that where a transformer is suitable for operation at two voltage ratings or at three voltage ratings, this flexibility will be definitely indicated on the nameplate, on the connection diagram, or on a poster inside the transformer cover. Standard transformers having voltage ratings listed above will be designed for full rated kv-a. output at any specified tap voltage (not exceeding 10 per cent range) without exceeding guaranteed temperature rise. The voltages 2300-4000Y are nominal voltages. The exact line voltage from three-2300-volt windings, star-connected is 3985 volts.

STANDARDIZATION OF DISTRIBUTION TRANSFORMERS—Continued

STANDARD TYPES, FREQUENCIES, SIZES, AND VOLTAGE RATINGS OF DISTRIBUTION TRANSFORMERS—Continued

Three-Phase, Sizes 200 Kv-a. and Below for Supplying Miscellaneous Lighting and Power Service

Standard Types { Oil-immersed, self-cooled.

Standard Frequencies { 25 cycles per second, 60 cycles per second.

Standard Sizes in kv-a. continuous ratings at 55° C. rise for three-phase transformers. { 5, 7.5, 10, 15, 25, 37.5, 50, 75, 100, 150 and 200

NOTE—See following table for sizes that are standard for the various voltage classes.

Standard Size Limits, Voltage Ratings and Taps of Three-Phase Transformers

Standard Line Voltages	Standard Sizes for Each Voltage Class	FOR SUPPLYING SERVICE VOLTAGES 600 AND BELOW			Transformer Low Voltage Ratings for Supplying Service Voltage 600 and Below
		TRANSFORMER HIGH VOLTAGE RATINGS FOR OPERATION FROM VARIOUS STANDARD SYSTEM VOLTAGES			
		On Full Winding	Approximately on 5% Tap on 10% Tap		
2300	5 to 200 incl.	2200/3810Y			..... to 220/440
		2300/4000Y			..... to 230/460
		2400/4150Y			..... to 240/480
4600	5 to 200 incl.	4400Y			..... to 220/440
		4600Y			..... to 230/460
		4800Y			..... to 240/480
6600	10 to 200 incl.	6600Y	6270	5940	..... to 220/440
		6900Y	6555	6210	..... to 230/460
		7200Y	6840	6480	..... to 240/480
11000	10 to 200 incl.	11000Y	10450	9900	..... to 220/440
		11500Y	10925	10350	..... to 230/460
13200	10 to 200 incl.	13200Y	12540	11880	..... to 220/440
		13800Y	13110	12420	..... to 230/460
22000	15 to 200 incl.	22000Y	20900	19800	..... to 220/440
		23000Y	21850	20700	..... to 230/460
33000	37.5 to 200 incl.	33000Y	31350	29700	..... to 220/440
		34500Y	32775	31050	..... to 230/460

NOTE—All sizes of distribution transformers having low voltage ratings of 230/460 are suitable for series or multiple three-phase service only by proper connection inside of the tank.

NOTE—Voltage ratings in bold type will be considered the normal voltage ratings of these lines and guarantees will be made only on these normal voltage ratings. It is understood, however, that where a transformer is suitable for operation at two-voltage ratings or at three-voltage ratings, this flexibility will be definitely indicated on the nameplate on the connection diagram or on a plaster inside the transformer cover.

Standard transformers having voltage ratings listed above will be designed for full rated kv-a. output at any specified tap voltage without exceeding guaranteed temperature rise.

In general standard three-phase distribution transformers are not suitable for multiple operation with a bank of standard single-phase distribution transformers as the angular displacement, turn ratio and impedance volts on which successful multiple operation depends are generally different on three-phase and single-phase transformers.



## POWER TRANSFORMERS OIL-INSULATED SELF-COOLED

Capacity Ratings 250 to 500 Kv-a. Inclusive

Voltage Ratings 2300 to 44,000 Volts

Single-Phase—25 and 60 Cycles

These transformers are oil-insulated, self-cooled, with high voltage ratings 2300 to 44,000 volts inclusive, for single-phase, 25 and 60 cycle service.

### Construction

The power transformers listed in the following pages are made in two general forms of construction, cruciform-core and simple-shell. A complete description of these two types is given on pages

623 and 624. The arrangement of coils and iron is shown diagrammatically for each of these types in Figure 2, while actual transformers are shown in Figures 17, 18 and 19.

### Instructions for Ordering

**Style Number**—Includes transformer only.

**List Price**—Includes transformer boxed for shipment and with necessary oil.

**Accessories**—All transformers are provided with thermometer, oil gauge, drain valve and filter press connections and oil sampling valve.

**Capacity and Voltage**—The capacity and voltage ratings are in agreement with the recommendations of the National Electric Light Association and of the Electric Power Club, (for table of standard voltage and capacity ratings refer to page 653) determined under the conditions specified in the standardization rules of the American Institute of Electrical Engineers.

The temperature rise under continuous full load does not exceed 55 degrees Centigrade above an ambient temperature of 40 degrees Centigrade.

The 4600-2300 volt ratings are provided with four 2½ per cent full-capacity taps when connected for 4600 volts and two 5 per cent taps when connected for 2300 volts. All other transformers listed are provided with four 2½ per cent full-capacity taps in the high-voltage winding.

**Secondary-Voltage Classes**—To facilitate listing the low-voltage windings are given in three classes, class 200, class 400 and class 500. Class 200 transformers are those whose highest low-voltage winding is nominally 200 volts (220, 230, 240). Class 400 transformers are those whose highest low-

voltage winding is nominally 400 volts (440, 460, 480). Class 500 transformers are those whose highest low-voltage winding is nominally 500 volts (550, 575, 600).

The low-voltage windings for the class 400 transformers are separated into two independent groups, the leads from which are brought out through the case. These two groups can be connected in multiple for the lower voltage and in series for the higher voltage; when connected for the higher voltage, the series connection may be used as the neutral lead for a three-wire circuit.

The low-voltage windings for the class 200 transformers are provided with low-voltage leads out of the case for 230 volts two-wire operation or for 230-115 volts three-wire operation, but the low-voltage coils cannot be connected in parallel for 115 volts.

In the tables listing the transformers, the high-voltage rating is given first, separated by the word "to" from the low-voltage rating. The high-voltage taps have been omitted for convenience from the voltage headings.

**Frequency**—Transformers are listed for use on 25 and 60-cycle circuits. For other frequencies prices will be furnished on request.

**Installation**—All transformers are suitable for indoor or outdoor installation.

**Polarity**—All of these transformers have subtractive polarity.

POWER TRANSFORMERS—Continued

SINGLE-PHASE 60-CYCLE TRANSFORMERS

Capacity Kv-a.	Type	OUTLINE DIMENSIONS Catalogue Dim. Page Reference		Dim. A	APPROXIMATE WEIGHT, POUNDS INCLUDING OIL Net Shipping†		STYLE NO. TRANSFORMER		Gallons Oil	List Price
<b>FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW</b>										
2200 to 220-110 Volts } Class 200					2200 to 440-220-Volts } Class 400					
2300 to 230-115 Volts }					2300 to 460-230 Volts }					
250	SS	643	33	86	5950	6250	297597‡	297601‡	225	\$1575 00
333	SS	643	35	107	6950	7300	297598‡	297602‡	290	1890 00
400	SS	643	43	114	8050	8450	297599‡	297603‡	395	2130 00
500	SS	643	44	129	9300	9760	297600‡	297604‡	470	2485 00
2200 to 550 Volts } Class 500					2300 to 575 Volts }					
250	SS	643	33	86	5950	6250	297605		225	1530 00
333	SS	643	35	107	6950	7300	297606		290	1820 00
400	SS	643	43	114	8050	8450	297607		395	2045 00
500	SS	643	44	129	9300	9760	297608		470	2365 00
4400-2200 to 220-110 Volts } Class 200					4400-2200 to 440-220 Volts } Class 400					
4600-2300 to 230-115 Volts }					4600-2300 to 460-230 Volts }					
250	SS	643	33	86	5950	6250	297609‡	297613‡	225	1600 00
333	SS	643	35	107	6950	7300	297610‡	297614‡	290	1915 00
400	SS	643	43	114	8050	8450	297611‡	297615‡	395	2150 00
500	SS	643	44	129	9300	9760	297612‡	297616‡	470	2510 00
4400-2200 to 550 Volts } Class 500					4600-2300 to 575 Volts }					
250	SS	643	33	86	5950	6250	297617		225	1555 00
333	SS	643	35	107	6950	7300	297618		290	1845 00
400	SS	643	43	114	8050	8450	297619		395	2065 00
500	SS	643	44	129	9300	9760	297620		470	2395 00
6600 to 440-220 Volts } Class 400					6900 to 460-230 Volts }					
250	SS	643	33	86	5950	6250	297621		225	1585 00
333	SS	643	35	107	6950	7300	297622		290	1910 00
400	SS	643	43	114	8050	8450	297623		395	2140 00
500	SS	643	44	129	9300	9760	297624		470	2370 00
6600 to 550 Volts } Class 500					6900 to 575 Volts }					
250	SS	643	33	86	5950	6250	297625		225	1540 00
333	SS	643	35	107	6950	7300	297626		290	1845 00
400	SS	643	43	114	8050	8450	297627		395	2060 00
500	SS	643	44	129	9300	9760	297628		470	2270 00
11000 to 440-220 Volts } Class 400					11500 to 460-230 Volts }					
250	SS	643	34	97	6300	6615	297629		250	1630 00
333	SS	643	35	108	7000	7350	297630		290	1940 00
400	SS	643	43	114	8100	8505	297631		395	2180 00
500	SS	643	44	129	9400	9870	297632		470	2415 00
11000 to 550 Volts } Class 500					11500 to 575 Volts }					
250	SS	643	34	97	6300	6615	297633		250	1580 00
333	SS	643	35	108	7000	7350	297634		290	1880 00
400	SS	643	43	114	8100	8505	297635		395	2095 00
500	SS	643	44	129	9400	9870	297636		470	2310 00
13200 to 440-220 Volts } Class 400					13800 to 460-230 Volts }					
250	SS	643	34	97	6400	6720	297637		250	1665 00
333	SS	643	35	108	7100	7455	297638		285	1990 00
400	SS	643	44	129	8900	9345	297639		480	2230 00
500	SS	643	44	129	9550	10030	297640		470	2470 00

†Shipping weight includes transformer boxed for shipment, complete with oil in tank.  
 Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.  
 ‡Class 200 low-voltage winding is arranged for 230 volts two-wire and 230-115 volts three-wire operation—but the low voltage coils cannot be connected in parallel for 115 volts.  
 §Style numbers for Class 400.  
 NOTE—The above 6900, 11500, and 13800 volt transformers are suitable for delta-connection, but not suitable for star-connection on the high voltage side when banked for three-phase operation. The 2300 and 4600 volt transformers are suitable for both star and delta-connection.

Order by Style Number

## POWER TRANSFORMERS—Continued

## SINGLE-PHASE 60-CYCLE TRANSFORMERS—Continued

Capacity Kv-a.	Type	OUTLINE DIMENSIONS			APPROXIMATE WEIGHT, POUNDS		Style No. Transformer	Gallons Oil	List Price
		Catalogue Page	Dim. Reference	Dim. A	Net	INCLUDING OIL Shipping†			
<b>FOR SUPPLYING SERVICE VOLTAGES 600 AND BELOW—Continued</b>									
13200 to 550 Volts } 13800 to 575 Volts } Class 500									
250	SS	643	34	97	6400	6720	297641	250	\$1620 00
333	SS	643	35	108	7100	7455	297642	285	1920 00
400	SS	643	44	129	8900	9345	297643	480	2145 00
500	SS	643	44	129	9550	10030	297644	470	2365 00
22000 to 440-220 Volts } 23000 to 460-230 Volts } Class 400									
250	SS	643	34	104	6500	6825	297645	246	1980 00
333	SS	643	35	115	7200	7550	297646	280	2235 00
400	SS	643	44	136	9000	9450	297647	475	2475 00
500	SS	643	44	136	9700	10200	297648	465	2830 00
22000 to 550 Volts } 23000 to 575 Volts } Class 500									
250	SS	643	34	104	6500	6825	297649	246	1840 00
333	SS	643	35	115	7200	7550	297650	280	2160 00
400	SS	643	44	135	9000	9450	297651	475	2380 00
500	SS	643	44	136	9700	10200	297652	465	2710 00
33000 to 440-220 Volts } 34500 to 460-230 Volts } Class 400									
250	SS	643	34	109	6800	7140	297653	234	2095 00
333	SS	643	43	126	8350	8770	297654	400	2410 00
400	SS	643	44	141	9400	9870	297655	480	2660 00
500	SS	643	44	141	9850	10350	297656	470	3030 00
33000 to 550 Volts } 34500 to 575 Volts } Class 500									
250	SS	643	34	109	6800	7140	297657	234	2035 00
333	SS	643	43	126	8350	8770	297658	400	2330 00
400	SS	643	44	141	9400	9870	297659	480	2560 00
500	SS	643	44	141	9850	10350	297660	470	2905 00
<b>FOR SUPPLYING DISTRIBUTION VOLTAGES ABOVE 600 VOLTS</b>									
6600 to 2300 Volts									
250	SS	643	33	86	5950	6250	297661	225	1510 00
333	SS	643	35	107	6950	7300	297662	290	1800 00
400	SS	643	43	114	8050	8450	297663	395	2005 00
500	SS	643	44	129	9300	9760	297664	470	2195 00
11000 to 2300 Volts									
250	SS	643	34	97	6300	6615	297665	250	1550 00
333	SS	643	35	108	7000	7350	297666	290	1835 00
400	SS	643	43	114	8100	8505	297667	395	2040 00
500	SS	643	44	129	9400	9870	297668	470	2240 00
13200 to 2300 Volts									
250	SS	643	34	97	6400	6720	297669	250	1590 00
333	SS	643	35	108	7100	7455	297670	285	1875 00
400	SS	643	44	129	8900	9345	297671	480	2090 00
500	SS	643	44	129	9550	10030	297672	470	2280 00
22000 to 2300 Volts									
250	SS	643	34	104	6500	6825	297673	246	1810 00
333	SS	643	35	115	7200	7550	297674	280	2110 00
400	SS	643	44	136	9000	9450	297675	475	2315 00
500	SS	643	44	136	9700	10200	297676	465	2625 00
33000 to 2300 Volts									
250	SS	643	34	109	6800	7140	297677	234	2000 00
333	SS	643	43	126	8350	8770	297678	400	2270 00
400	SS	643	44	141	9400	9870	297679	480	2495 00
500	SS	643	44	141	9850	10350	297680	470	2810 00
44000 to 2300 Volts									
250	SC	643	37	104	6800	7140	297689	254	2135 00
333	SC	643	46	114	9500	10100	297690	410	2485 00
400	SC	643	47	125	10700	11250	297691	480	2680 00
500	SS	643	47	125	11160	11720	297692	475	2990 00

†Shipping weight includes transformer boxed for shipment, complete with oil in tank.

Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.

NOTE—The above transformers are suitable for delta-connection, but not suitable for star-connection on the high voltage side when banked for three-phase operation.

Order by Style Number

POWER TRANSFORMERS—Continued

SINGLE-PHASE 25-CYCLE TRANSFORMERS

Capacity Kv-a.	Type	OUTLINE DIMENSIONS		APPROXIMATE WEIGHT, POUNDS		STYLE No. TRANSFORMER	Gallons Oil	List Price		
		Catalogue Page	Dim. Reference	Dim. A	INCLUDING OIL Net				Shipping†	
<b>FOR SUPPLYING SERVICE VOLTAGE 600 VOLTS AND BELOW</b>										
2200 to 220-110 Volts } Class 200					2200 to 440-220 Volts } Class 400					
2300 to 230-115 Volts }					2300 to 460-230 Volts }					
250	SS	643	35	107	7950	8350	297694†	297698‡	260	\$2340 00
333	SS	643	43	113	9350	9820	297695†	297699‡	370	2840 00
400	SS	643	44	128	10650	11200	297696†	297700‡	435	3250 00
500	SS	643	48	128	12950	13600	297697†	297701‡	605	3865 00
2200 to 550 Volts } Class 500					2300 to 575 Volts }					
250	SS	643	35	107	7950	8350	297702		286	2275 00
333	SS	643	43	113	9350	9820	297703		386	2745 00
400	SS	643	44	128	10650	11200	297704		467	3120 00
500	SS	643	48	128	12950	13600	297705		632	3690 00
4400-2200 to 220-110 Volts } Class 200					4400-2200 to 440-220 Volts } Class 400					
4600-2300 to 230-115 Volts }					4600-2300 to 460-230 Volts }					
250	SS	643	35	107	7950	8350	297706†	297710‡	260	2360 00
333	SS	643	43	113	9350	9820	297707†	297711‡	370	2860 00
400	SS	643	44	128	10650	11200	297708†	297712‡	435	3270 00
500	SS	643	48	128	12950	13600	297709†	297713‡	605	3885 00
4400-2200 to 550 Volts } Class 500					4600-2300 to 575 Volts }					
250	SS	643	35	107	7950	8350	297714		260	2290 00
333	SS	643	43	113	9350	9820	297715		370	2760 00
400	SS	643	44	128	10650	11200	297716		435	3135 00
500	SS	643	48	128	12950	13600	297717		605	3710 00
6600 to 440-220 Volts } Class 400					6900 to 460-230 Volts }					
250	SS	643	35	107	7950	8350	297718		260	2380 00
333	SS	643	43	113	9350	9820	297719		370	2885 00
400	SS	643	44	128	10650	11200	297720		435	3290 00
500	SS	643	48	128	12950	13600	297721		605	3920 00
6600 to 550 Volts } Class 500					6900 to 575 Volts }					
250	SS	643	35	107	7950	8350	297722		260	2310 00
333	SS	643	43	113	9350	9820	297723		370	2785 00
400	SS	643	44	128	10650	11200	297724		435	3160 00
500	SS	643	48	128	12950	13600	297725		605	3735 00
11000 to 440-220 Volts } Class 400					11500 to 460-230 Volts }					
250	SS	643	35	108	8100	8500	297726		260	2440 00
333	SS	643	43	114	9600	10080	297727		365	2950 00
400	SS	643	48	131	12800	13440	297728		605	3355 00
500	SS	643	48	131	13250	13900	297729		600	3975 00
11000 to 550 Volts } Class 500					11500 to 575 Volts }					
250	SS	643	35	108	8100	8500	297730		260	2370 00
333	SS	643	43	114	9600	10080	297731		365	2850 00
400	SS	643	48	131	12800	13440	297732		605	3225 00
500	SS	643	48	131	13250	13900	297733		600	3795 00
13200 to 440-220 Volts } Class 400					13800 to 460-230 Volts }					
250	SS	643	43	117	9150	9600	297734		370	2500 00
333	SS	643	44	132	10600	11130	297735		435	2990 00
400	SS	643	48	132	12900	13550	297736		600	3440 00
500	SS	643	48	132	13350	14000	297737		590	4050 00

†Shipping weight includes transformer boxed for shipment, complete with oil in tank. Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.

‡Class 200 low-voltage winding is arranged for 230 volts two-wire and 230-115 volts three-wire operation—but the low-voltage coils cannot be connected in parallel for 115 volts.

§Style numbers for Class 400.

NOTE—The above 2300 and 4600 transformers are suitable for star-connection or for delta-connection on the high voltage side when banked for three-phase operation. The transformers for higher voltages are suitable for delta connection only.

Order by Style Number

POWER TRANSFORMERS—Continued

SINGLE-PHASE 25-CYCLE TRANSFORMERS—Continued

Capacity Kv.-a.	Type	—OUTLINE DIMENSIONS—			APPROXIMATE WEIGHT POUNDS		Style No. Transformer	Gallons Oil	List Price
		Catalogue Page	Dim. Reference	Dim. A	Net	INCLUDING OIL Shipping†			
<b>FOR SUPPLYING SERVICE VOLTAGES 600 VOLTS AND BELOW—Continued</b>									
13200 to 550 Volts } Class 500 13800 to 575 Volts }									
250	SS	643	43	117	9150	9600	297738	370	\$2430 00
333	SS	643	44	132	10600	11130	297739	435	2890 00
400	SS	643	48	132	12900	13550	297740	600	3310 00
500	SS	643	48	132	13350	14000	297741	590	3870 00
22000 to 440-220 Volts } Class 400 23000 to 460-230 Volts }									
250	SS	643	43	121	9300	9765	297742	365	2735 00
333	SS	643	44	136	10800	11340	297743	435	3255 00
400	SS	643	48	136	13050	13700	297744	590	3750 00
500	SS	643	48	136	13700	14390	297745	570	4435 00
22000 to 550 Volts } Class 500 23000 to 575 Volts }									
250	SS	643	43	121	9300	9765	297746	365	2660 00
333	SS	643	44	136	10800	11340	297747	435	3175 00
400	SS	643	48	136	13050	13700	297748	590	3605 00
500	SS	643	48	136	13700	14390	297749	570	4235 00
33000 to 440-220 Volts } Class 400 35000 to 460-230 Volts }									
250	SS	643	43	126	9750	10250	297750	365	2905 00
333	SS	643	48	141	12800	13440	297751	605	3575 00
400	SS	643	48	141	13400	14070	297752	590	4125 00
500	SS	643	48	141	13900	14600	297753	565	4890 00
33000 to 550 Volts } Class 500 34500 to 575 Volts }									
250	SS	643	43	126	9750	10250	297754	365	2820 00
333	SS	643	48	141	12800	13440	297755	605	3455 00
400	SS	643	48	141	13400	14070	297756	590	3970 00
500	SS	643	48	141	13900	14600	297757	565	4675 00
<b>FOR SUPPLYING DISTRIBUTION VOLTAGES ABOVE 600 VOLTS</b>									
6600 to 2300 Volts									
250	SS	643	35	107	7950	8350	297758	260	2265 00
333	SS	643	43	113	9350	9820	297759	370	2720 00
400	SS	643	44	128	10650	11200	297760	435	3075 00
500	SS	643	48	128	12950	13600	297761	605	3620 00
11000 to 2300 Volts									
250	SS	643	35	108	8100	8500	297762	260	2325 00
333	SS	643	43	114	9600	10080	297763	365	2765 00
400	SS	643	48	131	12800	13440	297764	605	3185 00
500	SS	643	48	131	13250	13900	297765	600	3655 00
13200 to 2300 Volts									
250	SS	643	43	117	9150	9600	297766	370	2360 00
333	SS	643	44	132	10600	11130	297767	435	2825 00
400	SS	643	48	132	12900	13550	297768	600	3215 00
500	SS	643	48	132	13350	14000	297769	590	3750 00
22000 to 2300 Volts									
250	SS	643	43	121	9300	9765	297770	365	2610 00
333	SS	643	44	136	10800	11340	297771	435	3100 00
400	SS	643	48	136	13050	13700	297772	590	3510 00
500	SS	643	48	136	13700	14390	297773	570	4110 00
33000 to 2300 Volts									
250	SS	643	43	126	9750	10250	297774	365	2765 00
333	SS	643	48	141	12800	13440	297775	605	3375 00
400	SS	643	48	141	13400	14070	297776	590	3860 00
500	SS	643	48	141	13900	14600	297777	565	4530 00
44000 to 2300 Volts									
250	SC	643	46	113	10160	10650	297786	390	3010 00
333	SC	643	47	124	11760	12350	297787	450	3715 00
400	SS	643	50	135	13560	14230	297788	515	4290 00
500	SS	643	51	146	17050	17900	297789	830	5125 00

†Shipping weight includes transformer boxed for shipment, complete with oil in tank.

Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.

NOTE—The above transformers are suitable for delta-connection, but not suitable for star-connection on the high voltage side when banked for three-phase operation.

Order by Style Number

# HIGH-VOLTAGE DISTRIBUTION TRANSFORMERS

## Capacity Ratings 15 to 200 Kv-a. Inclusive

These transformers are oil-insulated, self-cooled, with voltage ratings 44,000 to 2300 volts for single-phase, 25 and 60-cycle service.

### Construction

The distribution transformers listed on this page are of the cruciform-core type of construction. A complete description of this type is given on page

623. The arrangement of the coils and iron is shown diagrammatically in Figure 2, while an actual transformer is shown in Figure 17.

### Instructions for Ordering

**Style Number**—Includes transformer only.

**List Price**—Includes the transformer boxed for shipment and with necessary oil in tank.

**Accessories**—Are furnished in accordance with the tabulation given on page 625 of this catalogue.

**Capacity and Voltage**—The capacity and voltage ratings are in agreement with the recommendations of the National Electric Light Association and of the Electric Power Club, (for tables of standard voltage and capacity ratings refer to page 653) determined under the conditions specified in the standardization rules of the American Institute of Electrical Engineers.

The temperature rise under continuous full load does not exceed 55 degrees Centigrade above an ambient temperature of 40 degrees Centigrade.

The 44,000-volt winding is provided with two 5 per cent full-capacity taps.

In the tables listing the transformers, the high-voltage rating is given first, separated by the word "to" from the low-voltage rating.

**Frequency**—The transformers are listed for use on a 60-cycle circuit. For other frequencies prices will be furnished on request.

**Installation**—These transformers are suitable for indoor or outdoor installation.

Capacity Kv-a.	Type	—OUTLINE DIMENSIONS—			APPROXIMATE WEIGHT, POUNDS INCLUDING OIL		Style No. Transformer	Gallons Oil	List Price
		Catalogue Page	Dim. Reference	Dim. A	Net	Shipping†			
<b>SINGLE-PHASE 60-CYCLE TRANSFORMERS</b>									
<b>FOR SUPPLYING DISTRIBUTING VOLTAGES ABOVE 600 VOLTS</b>									
<b>44,000 to 2300 Volts</b>									
15	SC	643	14	80	1900	2000	297681	100	\$ 708 00
25	SC	643	16	85	2200	2310	297682	120	822 00
37½	SC	643	15	92	2530	2660	297683	138	955 00
50	SC	643	19	104	2780	2920	297684	160	1075 00
75	SC	643	25	96	3830	4020	297685	165	1290 00
100	SC	643	26	102	4150	4360	297686	185	1515 00
150	SC	643	36	96	5800	6090	297687	225	1795 00
200	SC	643	37	104	6600	6930	297688	200	2000 00

<b>SINGLE-PHASE 25-CYCLE TRANSFORMERS</b>									
<b>FOR SUPPLYING DISTRIBUTING VOLTAGES ABOVE 600 VOLTS</b>									
<b>44,000 to 2300 Volts</b>									
15	SC	643	14	80	2080	2180	297778	100	Price on Application
25	SC	643	15	92	2510	2640	297779	116	
37½	SC	643	19	110	3420	3590	297780	184	
50	SC	643	18	102	4600	4830	297781	270	
75	SC	643	26	102	4770	5010	297782	174	
100	SC	643	37	104	6600	6930	297783	255	
150	SC	643	37	104	7050	7400	297784	250	
200	SC	643	45	103	8500	8920	297785	330	

†Shipping weight includes transformer boxed for shipment, complete with oil in tank. Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.  
NOTE:—The above transformers are suitable for delta-connection, but not suitable for star-connection on the high voltage side when banked for three-phase operation.

Order by Style Number

**TRANSFORMERS—SIZES ABOVE 200 KV-A.**

**Standard Types, Frequencies, Sizes and Voltage Ratings For Supplying Miscellaneous Lighting and Power Service**

**STANDARD TYPES**

**Oil-Immersed—Self-Cooled, of either Single-Phase or Three-Phase.** Oil-Immersed—Water-Cooled, of either Single-Phase or Three-Phase. Air-Blast, of either Single-Phase or Three-Phase. **NOTE—**The application for Air Blast Transformers should be confined to systems where the line of voltage does not exceed 25,000.

**STANDARD FREQUENCIES**

25 Cycles per Second 60 Cycles per Second

**STANDARD SIZES IN KV-A CONTINUOUS RATINGS AT 65 DEGREE C. RISE FOR SINGLE AND THREE-PHASE TRANSFORMERS**

Standard Sizes in Kva. Continuous Ratings for Each Voltage Class	OIL IMMERSED—SELF COOLED		OIL IMMERSED—WATER COOLED OR AIR BLAST	
	Single-Phase	Three-Phase	Single-Phase	Three-Phase
250	1667	2500	500	750
333	2000	3000	667	1000
400	2500	3750	833	1200
500	3333	5000	1000	1500
667	5000	6000	1250	1800
833	6667	7500	1667	2500
1000	8332	10000	2000	3000
1250	10000			

**NOTE—**See following table for sizes that are standard for the various voltage classes.

**STANDARD VOLTAGE RATINGS AND TAPS. ALSO STANDARD SIZE LIMITS FOR VARIOUS VOLTAGE CLASSES OF SINGLE-PHASE TRANSFORMERS**

STANDARD SIZES, VOLTAGE RATINGS AND TAPS OF SINGLE-PHASE TRANSFORMERS FOR SUPPLYING SERVICE VOLTAGES 600 AND BELOW

STANDARD SIZES, VOLTAGE RATINGS AND TAPS OF SINGLE-PHASE TRANSFORMERS FOR SUPPLYING DISTRIBUTION VOLTAGES ABOVE 600

Standard Line Voltages	Transformer High Voltage Ratings for Operation from Various Standard Line Voltages			Transformer Low Voltage Ratings for Supplying Service Voltages 600 and Below	Transformer Low Voltage Ratings for Supplying Nominal 2300- or 4000-volt Distribution
	On Full Winding	2 1/2%	5%		
2300	2200	2145	2090	220/110 (3-wire) -or- to 220/440 -or- to 550	
	2300*	2245	2185	2070 -or- to 230/115* (3-wire) -or- to 230/460 -or- to 575	
4600	2200	2090	2090	220/110 (3-wire) -or- to 220/440 -or- to 550	
	4400*	4180	4070	3960 -or- to 230/115* (3-wire) -or- to 230/460 -or- to 575	
	4600*	4485	4255	2070 -or- to 230/115* (3-wire) -or- to 230/460 -or- to 575	
6600	6600	6435	6270	6105	5940 -or- to 550
	6900*	6730	6555	6385	6210 -or- to 575
11000	11000	10725	10450	10175	9900 -or- to 550
	11500*	11215	10925	10640	10350 -or- to 575
13200	13200	12870	12540	12210	11880 -or- to 550
	13600*	13455	13110	12765	12420 -or- to 575
22000	22000	21450	20900	20350	19800 -or- to 550
	23000*	22425	21850	21275	20700 -or- to 575
35000	35000	32175	31350	30525	29700 -or- to 550
	34500*	33640	32775	31915	31050 -or- to 575

**NOTE—**Standard Single-Phase Substation Transformers for supplying nominal 2300- or 4000-volt distribution and having voltage ratings listed above, will be designed for successful operation when excited on full winding at 5 per cent above the rated voltage.

**NOTE—**Voltage ratings designated by "\*" will be considered the normal voltage ratings of these lines and guarantees will be made only on these normal voltage ratings. It is understood, however, that where a transformer is suitable for operation at two voltage ratings this flexibility will be definitely indicated on the nameplate, on the connection diagram or on a poster inside the transformer cover. Standard transformers having voltage ratings listed above will be designed for full rated kv-a. output at any specified tap voltage without exceeding guaranteed temperature rise.

## TYPE S BALANCE COILS

### For Alternating-Current Use

A balance coil is an auto-transformer used for obtaining a number of lower-voltage circuits from an alternating-current distributing system.

**Three-Wire**—Type S balance coils are listed for obtaining from a 230-volt two-wire circuit a three-wire 115-volt distribution system, as shown in Fig. 2.

**Five-Wire**—Type S balance coils are listed for obtaining from a 460-volt circuit a five-wire distribution system, as shown in Fig. 3.

**Capacity**—The rated kilovoltampere capacities of these coils represent the maximum unbalancing allowable between any two circuits. The balanced load does not pass through the balance coil. It is the general practice, where the degree of unbalance is not known, to use a balance coil with a capacity of approximately 25 per cent of the total maximum capacity of the circuit upon which it is used.

**Construction**—Type S balance coils are built with type S construction (see section on "Distribution Transformers").

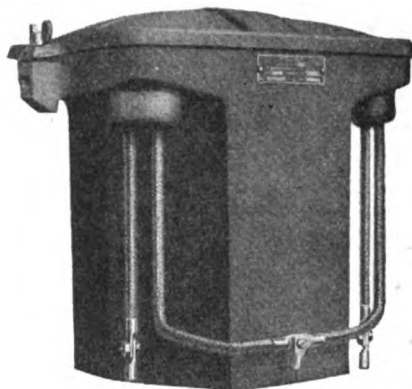


FIG. 1

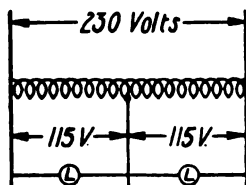


FIG. 2—THREE-WIRE COIL

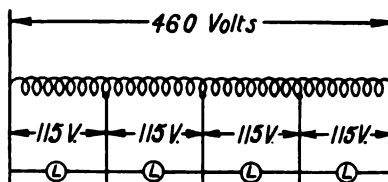


FIG. 3—FIVE-WIRE BALANCE COIL

### PRICES—Type S Balance Coils

Capacity† Kv-a.	DIMENSION Fig.	REFERENCE Item	APPROX. WT., LBS. Net*	Shipping†	ORDERING DATA			List Price
					Style No. Balance Coil	Style No. Hanger Iron	Gal. Oil	
<b>Three-Wire, 220-110 Volts, 230-115 Volts, 240-120 Volts</b>								
<b>60 Cycles</b>								
1½	4	1	59	70	305255	109712	¾	\$46 00
3	4	1	59	70	258723	109712	¾	54 00
5	4	2	105	135	279264	109712	1¾	62 00
7.5	4	3	132	175	258725	109712	1½	74 00
10	4	3	132	205	258726	109712	1¾	86 00
15	4	5	233	325	258727	109712	4½	110 00
25	4	9	280	430	258729	109712	10	140 00
<b>25 Cycles</b>								
1½	4	1	59	70	305254	109712	¾	84 00
3	4	2	105	135	138840	109712	1¾	104 00
5	4	6	205	275	138842	109713	3½	128 00
7.5	4	8	320	425	138843	109713	7	160 00
10	4	9	395	540	138844	109713	9¾	190 00
15	4	10	520	710	138845	109733	14	252 00
<b>Five-Wire, 440-330-220-110 Volts, 460-345-230-115 Volts, 480-360-240-120 Volts</b>								
<b>60 Cycles</b>								
1½	4	1a	80	110	305256	109712	1	60 00
3	4	3	132	175	249438	109712	1½	88 00
5	4	4	205	275	249439	109712	3½	120 00
7.5	4	6	320	425	249440	109712	5½	164 00
10	4	6	320	425	249441	109712	5½	208 00
15	4	8	680	990	249442	109712	9½	280 00

\*Net weight is of balance coil only. Oil weighs approximately 7 pounds per gallon.

†Shipping weight includes balance coil boxed for shipping and necessary oil in container. Shipping weight of oil is approximately 8 pounds per gallon.

‡The maximum unbalancing allowable between any two circuits.

These can be used with satisfactory performance on any voltage within 10 per cent greater or less than normal.

(See "Ordering Instructions" on Following Page)

Order by Style Number



TYPE S BALANCE COILS—Continued

ORDERING INSTRUCTIONS

**Style number** includes the balance coil only. **List price** includes the balance coil complete with necessary oil, but not with hanger irons or fuse blocks, which must be ordered separately.

**When ordering** specify as separate items:

**Balance Coil**—Give style number, capacity and voltage.

**Oil**—Give total quantity of oil required for all

balance coils on order. The quantity required for each coil is shown in the table.

**Hanger Irons**—Order by style number as listed in section on Distribution Transformers, one set for each balance coil ordered.

**Fuse Blocks**—Where fuse blocks are desired these should be ordered from section on "Fuse Blocks." (Order two per balance coil.)

OUTLINE DIMENSIONS

Balance Coils

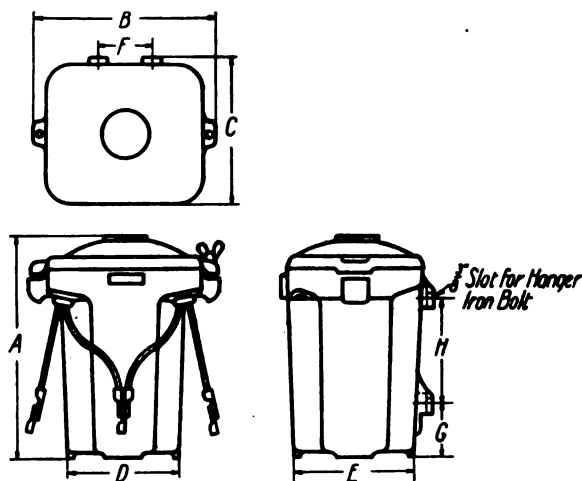


FIG. 4

DIMENSION REFERENCE		DIMENSIONS IN INCHES							
Fig.	Item	A	B	C	D	E	F	G	H
4	1	11 <sup>1</sup> / <sub>8</sub>	14 <sup>3</sup> / <sub>8</sub>	9 <sup>5</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>8</sub>	8 <sup>1</sup> / <sub>8</sub>	2 <sup>3</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	7
4	1a	12 <sup>1</sup> / <sub>8</sub>	15 <sup>1</sup> / <sub>8</sub>	12	9 <sup>1</sup> / <sub>8</sub>	9 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>8</sub>	7
4	2	12 <sup>3</sup> / <sub>4</sub>	15 <sup>3</sup> / <sub>4</sub>	12	10 <sup>1</sup> / <sub>2</sub>	10 <sup>1</sup> / <sub>2</sub>	3 <sup>1</sup> / <sub>4</sub>	2 <sup>3</sup> / <sub>4</sub>	7
4	3	14 <sup>1</sup> / <sub>2</sub>	15 <sup>1</sup> / <sub>2</sub>	12	10 <sup>5</sup> / <sub>8</sub>	10 <sup>5</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>2</sub>	2 <sup>1</sup> / <sub>2</sub>	7
4	4	18 <sup>1</sup> / <sub>2</sub>	18	13 <sup>3</sup> / <sub>4</sub>	11 <sup>3</sup> / <sub>4</sub>	11 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	3	7
4	5	20 <sup>1</sup> / <sub>2</sub>	18	13 <sup>3</sup> / <sub>4</sub>	11 <sup>3</sup> / <sub>4</sub>	11 <sup>3</sup> / <sub>4</sub>	3 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>2</sub>	7
4	6	21	19 <sup>3</sup> / <sub>8</sub>	15 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	11
4	7	23 <sup>3</sup> / <sub>4</sub>	19 <sup>3</sup> / <sub>8</sub>	15 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	11
4	8	28 <sup>1</sup> / <sub>4</sub>	19 <sup>3</sup> / <sub>8</sub>	15 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	11
4	9	28 <sup>1</sup> / <sub>8</sub>	19 <sup>3</sup> / <sub>8</sub>	15 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	13 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	3 <sup>1</sup> / <sub>8</sub>	11

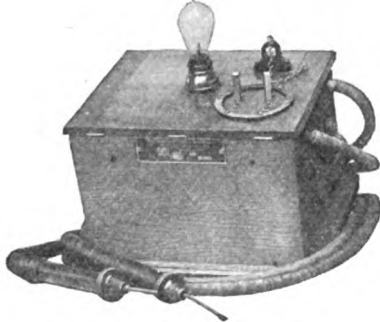
These dimensions are for reference only. For official dimensions apply to nearest district office.

Order by Style Number

## INSULATION-TESTING EQUIPMENT

### PORTABLE BENCH TYPE

For Use on 25 and 60-Cycle Circuits



PORTABLE BENCH-TYPE TESTING OUTFIT  
1/2 Kv.-a., 2000 VOLTS

The small 2000-volt outfit illustrated consists of a transformer mounted in a small wooden box and operated without oil.

The testing voltage can be varied in 100-volt steps up to 2000, and is quickly adjusted by means of two dial switches placed inside. The dials of these switches indicate the testing voltage on the basis of normal supply voltage.

A snap switch is provided in the low-voltage circuit to disconnect the outfit from the line; a pilot lamp is also provided to indicate when the outfit is energized. A fuse in the low-voltage circuit gives indication of the failure of the insulation under test.

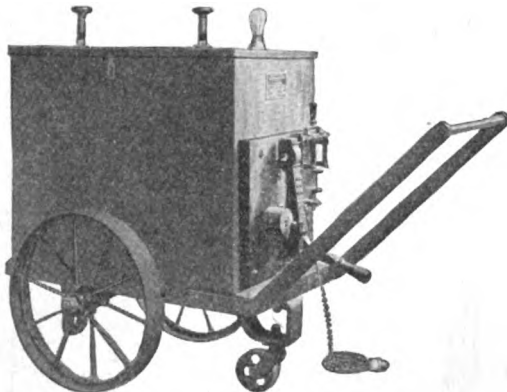
#### PRICES

Style number and list price include testing outfit complete as described.

Max. Testing Voltage	Capacity Kv.-a.	APPROX. Net	Wt., LBS. Shipping	APPROX. DIMENSIONS, INCHES		ORDERING DATA	
				Floor Space	Over-all Height	Style No. 110-220-Volt Low Voltage	List Price
2000	0.5	65	107	15x16	15	365353	\$316 00

### PORTABLE CARRIAGE TYPE

For Use on 25 and 60-Cycle Circuits



PORTABLE CARRIAGE-TYPE TESTING OUTFIT  
5 Kv.-a., 10,000 VOLTS

The testing voltage is varied by means of taps on the high-voltage side of the transformer and connected to contacts on two regulating dial switches. Pointers indicate the testing voltage on the basis of normal supply voltage. The dial switches are connected in the high-voltage circuit and the transformer should be disconnected from the line when adjusting the test voltage.

A knife switch and carbon circuit-breaker in the low-voltage circuit are used for connecting the outfit to the supply.

Heavily rubber-insulated testing leads and terminals are supplied. The terminals have insulated hand grips. Twelve feet of flexible lamp cord and a separable attachment plug are also provided.

**Special Safety Switch**—As a precaution to prevent unauthorized persons from operating these outfits, a safety switch can be added on special order. This is a push switch so mounted and connected that when the lid of the test box is closed the primary circuit of the transformer is opened; opening the lid automatically closes the circuit. A padlock can be attached to this lid.

#### PRICES

Style number and list price include standard outfit as described. The special safety switch will be furnished on these outfits on special order.

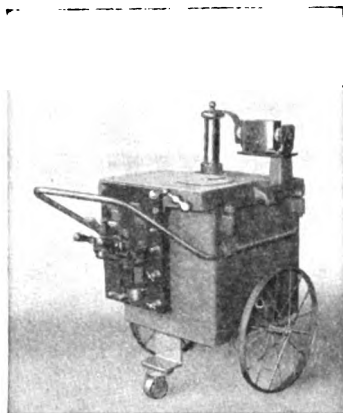
Max. Testing Voltage	Capacity Kv.-a.	Volts Per Step	APPROX. Net	Wt., LBS. Shipping	APPROX. DIMEN., INCHES		ORDERING DATA	
					Floor Space	Over-all Ht.	Style No. 110-220-Volt Low-Voltage	List Price
3000	2	250	500	913	27x47	37	366625	\$668 00
6000	2.5	200	525	1022	28x58	44	366626	828 00
10000	5	100	600	1132	28x58	44	366627	916 00
12000	5	200	600	1132	28x58	44	366628	960 00
16000	5	200	725	1315	34x59	42	366629	1000 00
Net addition to list price for special safety switch, not including padlock.....								12 00

Order by Style Number

## INSULATION-TESTING EQUIPMENTS—Continued

### PORTABLE TRUCK TYPE

Especially Adjusted for Oil Testing  
For Use on 60-Cycle Circuits



PORTABLE TRUCK-TYPE TESTING OUTFIT—  
3 Kv-a. 30,000 VOLTS

The portable truck-type illustrated is an outfit for oil and general insulation testing where but a small kv-a. capacity is required.

The transformer of this outfit is of the oil-insulated, self-cooled, core type, and is mounted with the control, which consists of an induction

regulator and an auto transformer, in a boiler-iron tank.

The testing voltage is varied by means of an induction regulator connected in the low-voltage circuit which provides a change in the high-tension voltage from zero to maximum without interruption and following a smooth curve.

Two methods are provided for indicating the test voltage. The regulator rotor shaft is equipped with a pointer which indicates on a dial the maximum test voltage. A tertiary or voltmeter winding is provided in the transformer, the leads of which are brought to suitable binding posts on the control panel and to these a voltmeter can be connected.

One end of the high-voltage winding of the transformer is permanently grounded inside of the tank. The other end is connected to an insulated terminal passing through the transformer cover.

A pilot lamp, two single-pole type CL carbon circuit-breakers, and two binding posts for connecting the outfit to single-phase supply, are provided in the low-voltage circuit.

Style number and list price include testing outfit complete as described. List price also includes the necessary oil.

Max. Testing Voltage	Capacity Kv-a.	Frequency Cycles	APPROX. Net* Wt. LBS.	Shipping†	APPROX. DIMEN. INCHES Floor Space	Height	Gal. Oil	Style No. 110-220-Volt Low Voltage	List Price
30,000	3	60	475	625	40x26	41	14½	368367	\$930 00

\*Net weight is of outfit only. Oil weighs approximately 7 pounds per gallon.  
†Shipping weight includes outfit complete, boxed for shipment, and the necessary oil in container. Shipping weight of oil is approximately 8 pounds per gallon.

### HIGH-CAPACITY TYPE

For General Insulation Testing

For Use on Circuits of 220-110 Volts and of Frequencies of 25 Cycles and Higher



HIGH-CAPACITY-TYPE  
TESTING OUTFIT  
7.5-Kv-a. 50,000 VOLTS

This outfit consists of a testing transformer of the core type and a regulating transformer mounted in a boiler-iron tank, both immersed in oil. One end of the high tension winding is grounded and the other end is brought out in a suitably insulated terminal. On special order this outfit can be mounted on an angle-iron truck frame provided with small iron wheels and handle.

On the slate panel are mounted: terminals for the supply wires; a double-pole knife switch for connecting to the supply circuit; cartridge fuses, a carbon-break circuit-breaker, a type TM voltmeter and the regulator handwheel.

The primary winding of the regulating transformer is connected directly to the supply circuit and the secondary has a number of taps brought up through the cover and connected to the dial contacts. Twenty steps of testing voltage, 2500 volts per step, are thus obtainable. Preventive resistances are connected so that the full range from 0 to 50,000 volts may be obtained by merely turning the hand-wheel and without opening the circuit.

#### PRICES

Style number and list price include testing outfit complete as described. List price also includes necessary oil.

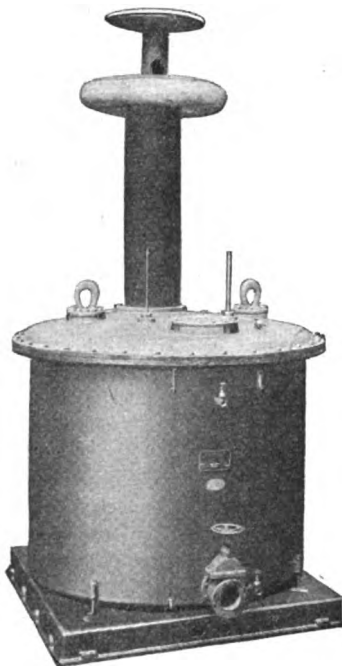
Max. Testing Voltage	Capacity Kv-a.	APPROX. Net* Wt. LBS.	Shipping†	APPROX. DIMEN. INCHES Floor Space	Over-all Height	Gal. Oil	ORDERING DATA	
							Style No. 110-220-Volt Low Voltage	List Price
50,000	7.5	1500	2000	26x31	77	90	236435	\$1920 00 150 00

Addition to list price for mounting outfit on truck.  
\*Net weight is of outfit only. Oil weighs approximately 7 pounds per gallon.  
†Shipping weight includes outfit complete, boxed for shipping, and necessary oil in container. Shipping weight of oil is approximately 8 pounds per gallon.

Order by Style Number

## INSULATION-TESTING EQUIPMENTS—Continued

## HIGH-VOLTAGE EQUIPMENTS

O. I. S. C. TESTING TRANSFORMER—500 Kv-A.  
500,000 VOLTS 60 CYCLES

For most high-voltage testing, large kilovolt-ampere capacity is not required and the smallest transformer economically designed is usually large enough. For cable testing, however, on account of the high electrostatic capacity involved, a large kilovolt-ampere capacity of transformer is required. This point must be given careful consideration as the capacity required for testing a cable system may amount to several thousand kilovoltamperes.



HAND-OPERATED DRUM-CONTROL SWITCH FOR VARYING VOLTAGE OF TESTING TRANSFORMERS (128 POINTS)

For testing purposes, it is usually necessary to have some means of regulating the testing voltage; therefore, a complete testing equipment consists of a testing transformer, regulating apparatus, switch-board control panel and voltage measuring device.

The three principal methods of control used quite extensively are as follows:

First—step-type control consisting of the regulating transformer with taps connected to a suitable drum controller, either hand or motor-operated as described below.

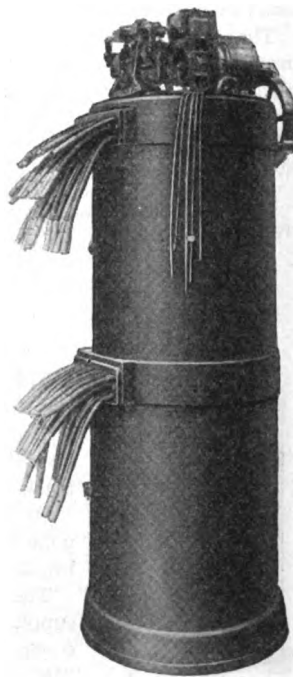
Second—induction-regulator control consisting of a special wound induction regulator connected direct to the testing transformer.

Third—a combination of both the induction regulator and step-type methods which is termed "step induction regulator" control. This method of control is becoming very popular and is used quite extensively for controlling the voltage on large electric furnaces.

Each problem in high-voltage and large capacity testing equipment should be treated as a special case and all inquiries of this nature should be referred to the Company.

A 128-point drum controller is operated by a hand wheel and, when used with a regulating transformer having the necessary taps, will provide 128 equal voltage steps from zero to maximum on the high-voltage side of the testing transformer.

The 480-point motor-operated drum controller operates on the same principle as the 128-point outfit, the only difference being the motor control and the available steps which are increased from 128 to 480.



MOTOR-OPERATED DRUM-CONTROL SWITCH FOR VARYING THE VOLTAGE OF TESTING TRANSFORMER (480 POINTS)

## PRICES—Voltage Regulating Devices

Style number and list price include the apparatus as described but without regulating transformer. Necessary oil is included in price of the combination, Style No. 238938.

Description	Number Steps	Capacity, Amps.	Approx. Net Wt. Lbs.	APPROX. DIMEN. INCHES	
				Floor Space	Over-all Ht.
Hand-operated drum controller	128	100	400	25½ diam.	42
Motor-operated drum controller	480	200	830	24 diam.	75

Order by Style Number

ORDERING DATA	
Style No.	List Price
178843	\$ 880 00
238937	1880 00

## INSULATION-TESTING EQUIPMENTS—Continued

## SPHERICAL-SPARK-GAP VOLTMETERS

The spherical-spark-gap voltmeters are constructed of two non-arcing metal spheres mounted vertically in suitable wooden frame work. As these spheres are formed in dies and are accurately machined and polished, they are very much more accurate than spun spheres. The lower sphere is at ground potential while the upper sphere is connected to the line through a resistor. Suitable micrometer adjustment is provided so that the separation of the spheres may be accurately determined.

All sizes, 125 to 500 millimeters inclusive, are of the same type of construction as shown in the illustration. The 50 millimeter size is built horizontally, and on account of its light weight is portable without the necessity of casters.

Prices will be furnished on request.

The following are the voltage ranges of the standard sizes:

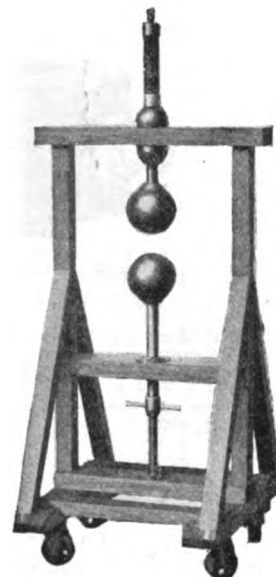
Diameter  
of Sphere  
Millimeters

50  
125  
250  
375  
500

Range in  
Kilovolts

10-75  
30-160\*  
60-280\*  
70-350  
80-400\*

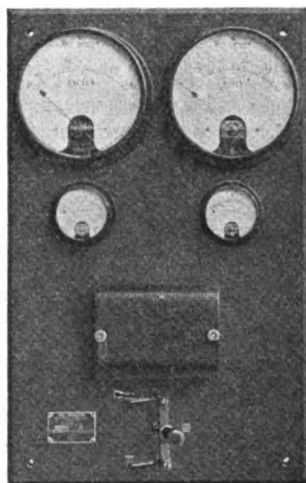
\*Range recommended by A. I. E. E. Rules for 1915.



## CREST-VOLTMETER OUTFITS

The crest-voltmeter outfit is used with the condenser-type bushing of a testing transformer. It is standard Westinghouse practice to furnish condenser-type bushings with all testing transformers having voltages of 75,000 and higher and by special arrangement, transformers with voltages as low as 30,000 may be equipped with the condenser bushing.

Westinghouse transformers now in service, equipped with a condenser bushing, can be used by changing the bushing slightly.



**Operation**—The principle upon which this device operates is that the average value of the half wave of the charging current in a condenser bushing, which charging current flows into and out of the bushing when the latter is subjected to a voltage strain, is proportional to the crest of the voltage wave. The charging current is rectified by means of small mercury bulbs and measured by a sensitive direct-current milli-ammeter that is calibrated in terms of

the high-voltage alternating-current voltage. The deflection of the instrument is proportional to the maximum value of the voltage wave; and, since the instrument is a direct-current instrument, all the scale divisions are approximately equal. This makes it possible to read low voltages on the scale with the same accuracy as the higher voltages, a very important and desirable feature in insulation testing.

The readings of the crest-voltmeter are not affected by the electrostatic capacity of the testing load, by changes in the amount of the testing load, or by atmospheric conditions; they are, however, affected by the frequency of the supply circuit and for this reason a frequency meter is supplied. The readings of the crest-voltmeter vary directly with the frequency so that a correction can easily be made for any variation in frequency from that for which it is calibrated.

The readings are theoretically correct for all voltage waves having not more than one maximum and one minimum value per cycle, and are practically correct for all other commercial wave-shapes.

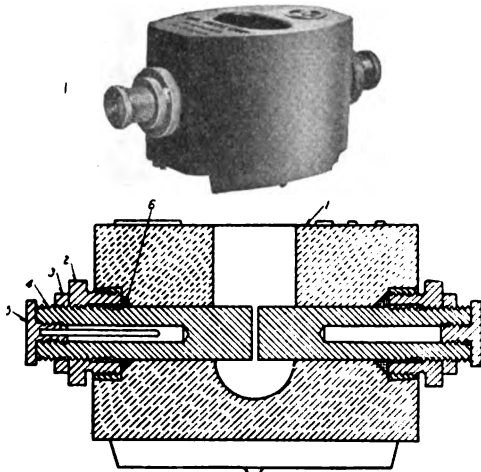
For use on special wave forms having more than one maximum and minimum per cycle, special crest voltmeter outfits can be furnished, using synchronous motor rectifier instead of mercury bulbs.

**Construction**—The complete equipment of the crest-voltmeter outfit consists of a small slate panel mounted on pipe framework, as shown, and upon the panel is mounted a frequency meter, a direct-reading highly sensitive milli-ammeter specially calibrated to read crest voltages, two small rectifier bulbs, and a change-over switch.

This device can be furnished, as stated above, for voltages of from 30 kilovolts up. The normal voltage is determined by the normal voltage of the transformer with which it is to be used. Prices will be furnished on request.

INSULATION-TESTING EQUIPMENTS—Continued

OIL TESTING CUP



OIL TESTING CUP

- 1—CUP
- 2—PACKING GLAND
- 3—LOCK-NUT
- 4—ELECTRODE
- 5—GAP-GAUGE AND BINDING POST
- 6—PACKING

The oil testing cup shown in the cut is used to determine the suitability of an oil for insulating purposes.

The maximum voltage required for reliable testing is 25,000 volts. Higher voltages may be used if available, but it is seldom that 30,000 volts will be required to discharge across the standard gap through any insulating oil.

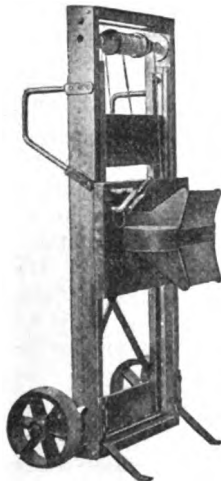
The gap terminals are flat disks, one inch in diameter, with square edges. The standard gap is 0.10 inch. The gap is locked in position after setting against a feeler gauge. All metal parts are of brass, except the steel feeler gauge, which is attached to one of the binding posts.

Style number and list price include testing cup and spark gap complete as described.

APPROX. WT. LBS.	DIMENSIONS		Style No.	List Price
	Net	Shipping		
6½	12	8½ x 4 x 4¾	263621	\$70 00

ARMATURE-TESTING EQUIPMENTS

For Use on 25 and 60-Cycle Circuits



PORTABLE ARMATURE-TESTING EQUIPMENT

The armature-testing outfit, illustrated, consists of a laminated iron core in which an alternating magnetic flux is set up by connecting the terminals of its exciting coil to a source of alternating current. When either a direct-current or an alternating-current wave-wound (two-circuit)\* armature of the commutator type is placed against the face of this core, which is shaped to fit an armature, an alternating flux passes through the armature core. If the armature winding is correct, the electromotive forces generated counterbalance each other and no current passes through the winding.

The core is mounted on a stand provided with wheels or on a stationary stand. It is used in a vertical position close to the armature. Two sizes are made, one for armatures up to 12 inches in diameter and one for armatures 12 inches or more in diameter.

PRICES

Style number and list price include the equipment complete as described. No extension cord for connecting to supply circuit is furnished.

Type	For Armature Diameter	APPROX. WT. LBS.		APPROX. DIMEN. INCHES		ORDERING DATA	
		Net	Shipping	Floor Space	Over-all Height	Style No. 110-220-Volt	List Price
Portable	Up to 12 inches	200	430	20½x24½	55¾	366622	\$420 00
Portable	12 Inches and larger	260	490	18¾x26½	51½	366620	450 00
				Wall Space	Over-all Height		
Stationary	Up to 12 inches	80	110	14½x18	11¼	366623	250 00
Stationary	12 Inches and larger	100	147	14½x20	9¾	366621	280 00

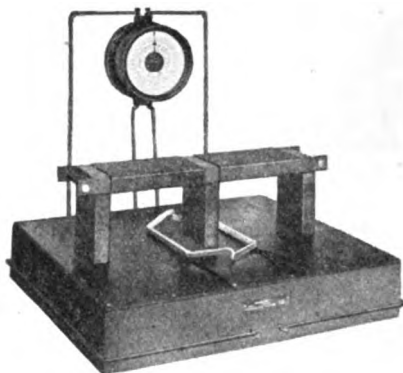
\*There are two main classes of armatures, known familiarly as "lap-wound" or "multiple" and "wave-wound" or "two-circuit" armatures. In the first class equalizer connectors are used to connect points of the same potential. Where one side of such an armature is excited by this testing equipment the entire armature will appear to be short-circuited due to the equalizer connections, and because of this condition the spark at the commutator is very weak. This same effect is produced by the connections to the slip rings in the armatures for rotary converters of three-wire generators. This testing equipment is therefore suitable only for use with wave-wound (two-circuit) armatures.

Order by Style Number

## INSULATION-TESTING EQUIPMENTS—Continued

## COIL-TESTING EQUIPMENTS

For Use on 60-Cycle Circuits



COIL TESTING EQUIPMENT WITH WATTMETER

A device for locating faults in armature and field coils before the winding is put in place is illustrated in cut.

The apparatus consists of an E-shaped electromagnet with a detachable yoke. The exciting coil

is on the middle leg of the E. On the back of the E, between the middle leg and each outside leg are wound two small coils so connected that the electromotive forces induced in them oppose and accurately balance each other.

**Operation**—The field or armature coil to be tested is placed over one of the outer legs of the E and the yoke is omitted. If the tested coil is without fault it has no effect on the flux distribution. If, however, a short-circuit exists, a current is induced in the tested coil which so alters the distribution of the flux that more passes through one of the detecting coils than through the other, inducing higher voltage in one than in the other, and thus causing a current to flow through them. Such current can be detected by means of a zero-center wattmeter or by means of a telephone receiver.

To locate a short-circuit in a coil by burning it out, the coil is placed on the middle leg of the E, the detachable yoke put in place as shown in illustration, and the exciting coil connected to the line for a short time.

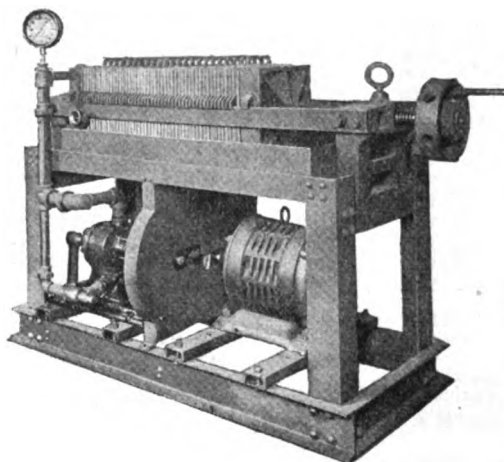
## PRICES

**Style number** includes outfit complete except wattmeter. The list price, however, includes a wattmeter of the proper style number, but does not include wattmeter leads.

Volts	Aprox. Net Wt. Pounds	APPROX. DIMENSIONS INCHES		ORDERING DATA		
		Floor Space	Over-all Height	Outfit STYLE NOS.	Wattmeter	List Price
110	275	27x30	14½	107513	164353	\$480 00
220	275	27x30	14½	107514	164354	480 00
Deduction from list price for omission of wattmeter.....						40 00
Addition to list price for special telephone receiver.....						8 00

Order by Style Number

## OIL DRYING AND PURIFYING OUTFITS



TYPE A-30 OIL DRYING AND PURIFYING OUTFIT

It is becoming the general practice of central stations to dehydrate and purify insulating oil that has absorbed moisture and sediment. To successfully and economically treat this oil in large quan-

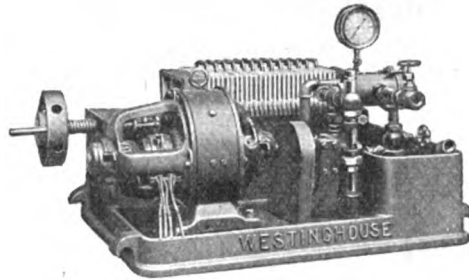
ties, the Westinghouse Electric and Manufacturing Company has developed a special type of filtering outfit. In this outfit the oil to be purified is forced through several layers of specially prepared filter paper.

There are five standard sizes listed, divided into two main classes corresponding to the size of the filter paper used. Each complete outfit consists of filter press, motor, pump, oil strainer, pressure gauge, and piping.

**Filter Paper**—The filter paper used is a special grade of white blocking paper. Five sheets cut to proper size, 12½ inches square for the Class A outfit, and 7¾ inches square for the Class B outfit, are used between each plate and the adjacent frame of the filter press. The paper should be thoroughly dried before using.

**Drying Oven**—The oven for drying the filter paper is electrically heated and is built of sheet iron with double walls. These ovens are furnished in sizes designated by type A-30, A-10, and B, to correspond to the size and quantity of filter paper they will hold.

OIL DRYING AND PURIFYING OUTFITS—Continued



TYPE A-10 OIL DRYING AND PURIFYING OUTFIT

PRICES

Filter Press Outfits

Style number and list price include the outfit complete with motor but do not include the drying oven. With the Class A outfits, three packages of filter paper (480 sheets per package) are included and with Class B outfits, two packages.

Voltage	Phase	MOTOR Cycles	H. P.	Style No.	Sheets of Paper Required per Charge	Net Weight Pounds	Shipping Weight Pounds	Style No.	List Price
<b>TYPE A-30</b>									
110	2	25	5	.....	240	2000	2200	229752	\$1500 00
220	2	25	5	246633	240	2000	2200	229753	1500 00
440	2	25	5	246634	240	2000	2200	229754	1500 00
110	3	25	5	.....	240	2000	2200	229755	1500 00
220	3	25	5	246635	240	2000	2200	229756	1500 00
440	3	25	5	246636	240	2000	2200	229757	1500 00
110	1	60	5	.....	240	2000	2200	232193	1580 00
220	1	60	5	.....	240	2000	2200	232194	1580 00
440	1	60	5	.....	240	2000	2200	.....	1580 00
110	2	60	5	302435	240	2000	2200	366985	1420 00
220	2	60	5	284739	240	2000	2200	366986	1420 00
440	2	60	5	284740	240	2000	2200	366987	1420 00
110	3	60	5	302436	240	2000	2200	366988	1420 00
220	3	60	5	284741	240	2000	2200	366989	1420 00
440	3	60	5	284742	240	2000	2200	366990	1420 00
115	d-c.	d-c.	5	143695	240	2000	2200	229764	1550 00
230	d-c.	d-c.	5	216339	240	2000	2200	229765	1550 00
550	d-c.	d-c.	5	143700	240	2000	2200	229766	1550 00
<b>TYPE A-20</b>									
110	2	25	3	.....	180	1800	2000	232176	1280 00
220	2	25	3	246629	180	1800	2000	232177	1280 00
440	2	25	3	246630	180	1800	2000	232178	1280 00
110	3	25	3	.....	180	1800	2000	232179	1280 00
220	3	25	3	246631	180	1800	2000	232180	1280 00
440	3	25	3	246632	180	1800	2000	232181	1280 00
110	1	60	3	.....	180	1800	2000	232182	1390 00
220	1	60	3	.....	180	1800	2000	232183	1390 00
440	1	60	3	.....	180	1800	2000	.....	1390 00
110	2	60	3	302431	180	1800	2000	366979	1210 00
220	2	60	3	284729	180	1800	2000	366980	1210 00
440	2	60	3	284730	180	1800	2000	366981	1210 00
110	3	60	3	302432	180	1800	2000	366982	1210 00
220	3	60	3	284731	180	1800	2000	366983	1210 00
440	3	60	3	284732	180	1800	2000	366984	1210 00
115	d-c.	d-c.	3	143688	180	1800	2000	232190	1295 00
230	d-c.	d-c.	3	143690	180	1800	2000	232191	1295 00
550	d-c.	d-c.	3	143692	180	1800	2000	232192	1295 00

Portability—On special order and at an addition to list price of \$45.00, four casters can be mounted on the base of any of these outfits, thus adapting them to portable service.

Order by Style Number



## OIL DRYING AND PURIFYING OUTFITS—Continued

## PRICES OF FILTER PRESS OUTFITS—Continued

Voltage	Phase	MOTOR Cycles	H. P.	Style No.	Sheets of Paper Required Per Charge	Net Weight Pounds	Shipping Weight Pounds	Style No.	List Price
<b>Type A-10</b>									
110	2	25	2	.....	140	1500	1700	366967	870 00
220	2	25	2	316688	140	1500	1700	366968	870 00
440	2	25	2	316689	140	1500	1700	366969	870 00
110	3	25	2	.....	140	1500	1700	366970	870 00
220	3	25	2	316690	140	1500	1700	366971	870 00
440	3	25	2	316691	140	1500	1700	366972	870 00
110	1	60	2	173517	140	1500	1700	232174	970 00
220	1	60	2	173517	140	1500	1700	232175	970 00
440	1	60	2	.....	140	1500	1700	.....	970 00
110	2	60	2	294057	140	1500	1700	366973	855 00
220	2	60	2	294058	140	1500	1700	366974	855 00
440	2	60	2	294059	140	1500	1700	366975	855 00
110	3	60	2	294060	140	1500	1700	366976	855 00
220	3	60	2	294061	140	1500	1700	366977	855 00
440	3	60	2	294062	140	1500	1700	366978	855 00
115	d-c.	d-c.	2	212667	140	1500	1700	366991	970 00
230	d-c.	d-c.	2	212668	140	1500	1700	366992	970 00
550	d-c.	d-c.	2	212669	140	1500	1700	366993	970 00
<b>Type B-5</b>									
110	2	25	1	225193	140	700	850	232159	570 00
220	2	25	1	225194	140	700	850	232160	570 00
440	2	25	1	.....	140	700	850	.....	570 00
110	3	25	1	225196	140	700	850	232161	570 00
220	3	25	1	225197	140	700	850	232162	570 00
440	3	25	1	.....	140	700	850	.....	570 00
110	1	60	1	203364	140	700	850	366965	610 00
220	1	60	1	203364	140	700	850	366966	610 00
440	1	60	1	.....	140	700	850	.....	610 00
110	2	60	1	320208	140	700	850	232165	560 00
220	2	60	1	320209	140	700	850	232166	560 00
440	2	60	1	320210	140	700	850	232167	560 00
110	3	60	1	320211	140	700	850	232168	560 00
220	3	60	1	320212	140	700	850	232169	560 00
440	3	60	1	320213	140	700	850	232170	560 00
115	d-c.	d-c.	1	172410	140	700	850	232171	600 00
230	d-c.	d-c.	1	172411	140	700	850	232172	600 00
550	d-c.	d-c.	1	212663	140	700	850	232173	600 00
<b>Type B-2½</b>									
110	2	25	¼	225179	90	650	775	172877	480 00
220	2	25	¼	225180	90	650	775	172878	480 00
440	2	25	¼	.....	90	650	775	.....	480 00
110	3	25	¼	225182	90	650	775	172879	480 00
220	3	25	¼	225183	90	650	775	172880	480 00
440	3	25	¼	.....	90	650	775	.....	480 00
110	1	60	¼	309073	90	650	775	366961	495 00
220	1	60	¼	309073	90	650	775	366962	495 00
440	1	60	¼	.....	90	650	775	.....	495 00
110	2	60	¼	.....	90	650	775	172881	465 00
220	2	60	¼	320187	90	650	775	172882	465 00
440	2	60	¼	320188	90	650	775	172883	465 00
110	3	60	¼	320189	90	650	775	172884	465 00
220	3	60	¼	320170	90	650	775	172885	465 00
440	3	60	¼	320171	90	650	775	172886	465 00
115	d-c.	d-c.	¼	273675	90	650	775	366963	490 00
230	d-c.	d-c.	¼	273676	90	650	775	366964	490 00

**Portability**—On special order and at an addition to list price of \$45.00, four casters can be mounted on the base of any of these outfits, thus adapting them to portable service.

*Order by Style Number*

OIL DRYING AND PURIFYING OUTFITS—Continued

DRYING OVENS

Style number and list price include oven complete with rack, suspension rods, heating elements, and snap switch. No extension cord for connecting to supply line is provided. The type A-30 oven is used with the types A-30 and A-20 oil treating outfits, the type A-10 oven is used with the type A-10 outfit, and the type B oven is used with the type B-5 and B-2½ outfits.

Oven Type	Voltage	Watts	APPROX. WT. LBS.		Style Number	List Price
			Net	Shipping		
A-30	100-112	1600-800-400	200	375	226571	\$370 00
A-30	113-125	1600-800-400	200	375	226572	370 00
A-30	200-225	1600-800-400	200	375	226573	370 00
A-30	226-250	1600-800-400	200	375	226574	370 00
A-10	100-112	800-400-200	80	150	175509	160 00
A-10	113-125	800-400-200	80	150	175510	160 00
A-10	220-225	800-400-200	80	150	175511	160 00
A-10	226-250	800-400-200	80	150	175512	160 00
B	100-112	400-200-100	40	75	175513	130 00
B	113-125	400-200-100	40	75	175514	130 00
B	200-225	400-200-100	40	75	175515	130 00
B	226-250	400-200-100	40	75	175516	130 00

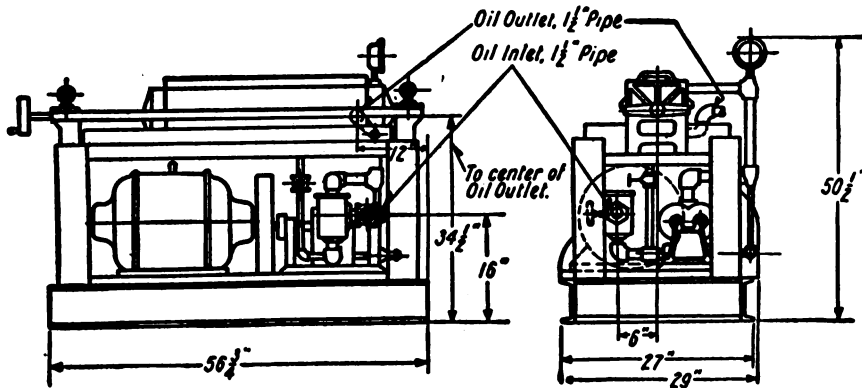
FILTER PAPER

Three reams of filter paper are furnished without additional charge with all type A filter press outfits, and two with all type B filter press outfits. Extra paper can be furnished in standard packages of one ream (480 sheets) per package, at the following list prices:—

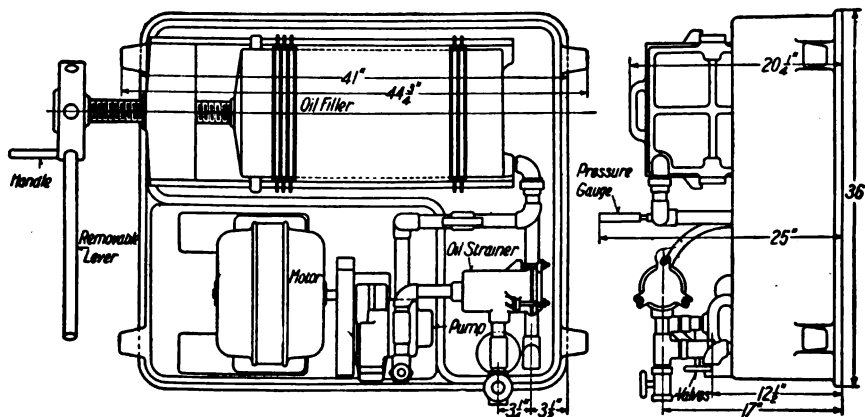
Type of Filter Press Outfit	Approx. Net Wt. Lbs.	Style No.	List Price
A-30	44	178647	\$20 00
A-20	44	178647	20 00
A-10	44	178647	20 00
B-5	13	178766	8 00
B-2½	13	178766	8 00

Order by Style Number

OUTLINE DIMENSIONS



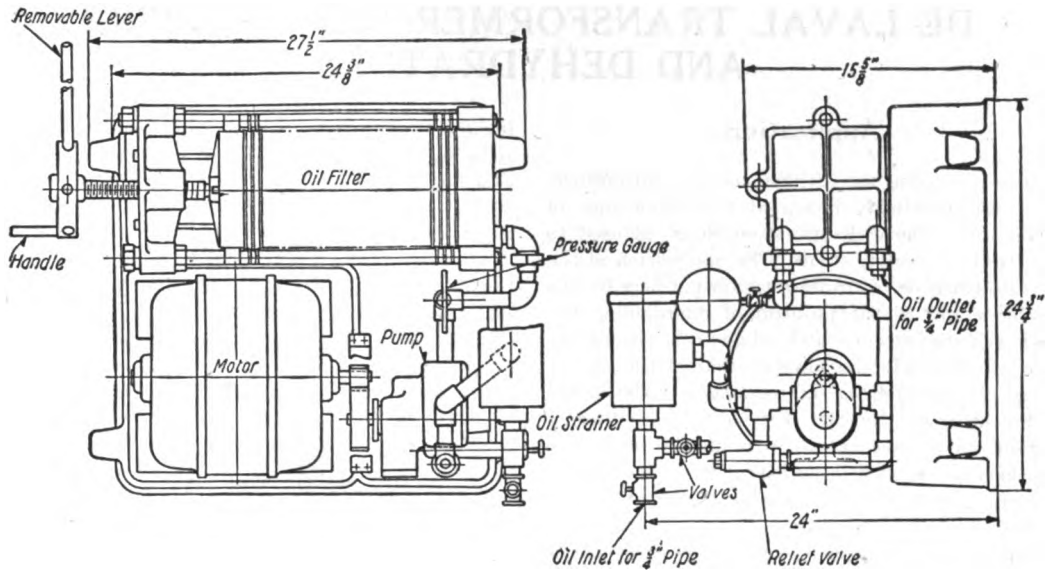
TYPES A-30 AND A-20 OUTFITS



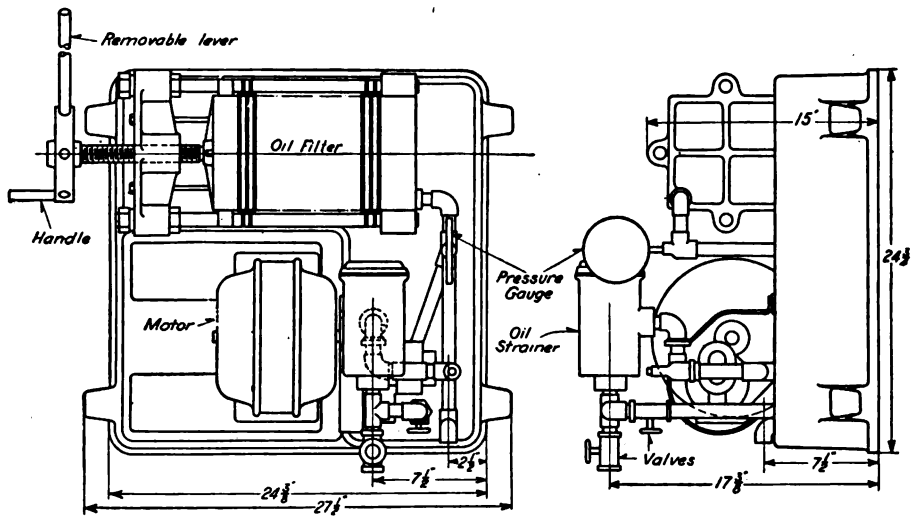
TYPE A-10 OUTFIT

4-323A

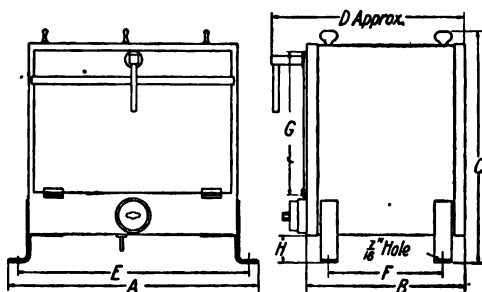
OIL DRYING AND PURIFYING OUTFITS—Continued



TYPE B-5 OUTFIT



TYPE B-2 1/2 OUTFIT



DRYING OVEN

Type	INCHES		
	A-30	A-10	B
A	49 5/8	26 3/8	18 1/2
B	16 1/8	16 3/8	11 1/2
C	22 3/8	22	16 3/4
D	19 1/2	19 1/4	14
E	48 1/8	24 1/2	16 3/8
F	13 1/4	13 1/2	8 3/4
G	15 3/8	15 3/8	10 3/4
H	1 1/2	1 1/2	1 1/2

These dimensions are for reference only. For official dimensions apply to nearest district office.

## DE LAVAL TRANSFORMER OIL PURIFIERS AND DEHYDRATORS

### Application

The increasing use of high voltage transformers has correspondingly increased the importance of maintaining the dielectric strength of oil used to cool and to insulate them. The application of the centrifugal type of transformer oil purifiers to this problem and to the problem of maintaining the dielectric strength of switch oil and other insulating oils, is essentially the same as that of the blotter press, except for the actual removal of moisture and sediment from the oil. Instead of the filtering action which takes place in a blotter press, the purifier throws the impurities out of the oil by centrifugal force, no filter media of any kind being used.

**Capacity**—The capacity of the purifier varies with the condition and the temperature of the oil. In handling fairly clean oil at a temperature of approximately 50 degrees Centigrade the larger machine will produce about 300 gallons of dehydrated oil per hour. When working on similar oil the smaller unit will deliver at least 100 gallons of dehydrated oil per hour. After one passage through a machine the oil will test 22,000 volts or better with the new standard test gap having one-inch electrodes with  $\frac{1}{8}$  of an inch separation.

Under more favorable conditions, greater capacities and higher readings of dielectric strength can often be obtained with but one passage of the oil through the purifier. Further increases in both capacity and break-down tests are possible by re-running the oil, but it is not recommended that this be done since a satisfactory test can be had with one passage through the machine, and the higher capacity obtained by re-running the oil is usually more than offset by the extra time required to make the two runs.

**Other classes of service**—This machine is of similar type to those designed to separate liquids of different specific gravities and with some sacrifice of efficiency can be used for various separating problems. However, to obtain the maximum efficiency and capacity in handling transformer and other insulating oil, the bowl is specifically designed for this purpose, the discs being very closely spaced and of large diameter. This fine stratification and large effective disc surface assists greatly in removing the last particle of moisture present in an oil but reduces somewhat the sediment holding capacity of the bowl. The machines, therefore,

do not represent as desirable apparatus for purifying lubricating and engine oil, as others designed specifically for such purposes.

### Operation

The important part of the centrifugal purifier is the revolving chamber known as the bowl, in which purification or separation takes place. In order for the bowl to meet the widest range of conditions



FIG. 1—STANDARD TRANSFORMER-OIL PURIFIER OUTFIT

it is constructed so that it can be used in two different ways, as follows: First, it can be assembled to function as a separating bowl, discharging the water continuously. This necessitates sealing the bowl with water before starting and when assembled in this manner it is known as a PURIFIER BOWL. Second, it can be assembled to function as a clarifying bowl and as such all water removed is held in the bowl. When assembled in this manner it is known as a DEHYDRATOR BOWL.

For oil which tests below 14,000 volts it is recommended to use the bowl as a purifier, since the dielectric strength of the oil indicates the presence of

## DE LAVAL TRANSFORMER OIL PURIFIERS AND DEHYDRATORS—Continued

considerable moisture. For oil testing above 14,000 volts, it is recommended, to use the bowl as a dehydrator since the amount of moisture to be removed is small, and the absence of a water seal makes dehydration all the more sure. For all ordinary conditions, the bowl is assembled for dehydration.

The quantity of oil which can be handled before it becomes necessary to clean out the sediment pockets of the bowl depends entirely upon the condition of the oil. Working with oil which tests above 14,000 volts, from 3000 to 9000 gallons can usually be handled before cleaning, while with oil testing less than 14,000 volts from 1000 to 3000 gallons can be run.

**Power Requirements**—The brake horse power required to operate the small size machine is .65; for the large size machine, 1.42. The steam turbine driven purifiers, known as Style Nos. 359606 and 359610 require respectively 75 pounds of steam per hour and 160 pounds of steam per hour at 60

portable service. The small machine is rated at 100 gallons of oil per hour when working with oil testing above 14,000 volts, to 35 gallons per hour when working with oil testing below 14,000 volts. The large machine is rated at 300 gallons per hour when working with oil testing above 14,000 volts, to 100 gallons per hour when working with oil testing below 14,000 volts. These figures are given as a minimum, for producing efficiently, oil testing 22,000 volts or better with one passage through the machine. For stationary service, Fig. 1, the purifier can be furnished for belt, electric-motor, or direct-connected steam-turbine drive. For portable service, Fig. 2, a motor-driven machine is furnished.

**Mechanical Details**—The arrows in the cross-section of the dual-purpose bowl (See Fig. 3) indicate the course of the oil and impurities through the bowl when used either as a dehydrator or a purifier. The left-hand side of the illustration shows how, when the bowl is assembled for dehydration, the dirty oil fed into the top of the machine passes to the bottom of the bowl and upward through the holes in the series of discs, and also how the water and sediment are thrown by centrifugal force into the sediment pockets at the outer edge of the bowl while the dehydrated oil is forced upward along the inner ends of the discs and discharged. When the bowl is assembled for purification, as shown in the right-hand side of the illustration the same action takes place except that the water is forced upward along the outer edges of the discs and is discharged through a separate outlet. The change from one type of bowl to the other can be made in a few minutes.

The purpose of the discs in the bowl is to facilitate purification by dividing the liquid into thin sheets or layers to lessen the conflict between the currents of purified and unpurified oil, and thus to make it possible to run the machine at what, for a centrifugal separator or purifier, is the low speed of 6000 rpm. In earlier types of centrifugal machines oil was purified while in a mass, however, the principle of dividing it into thin sheets renders separation much easier.

The greater ease in dehydration when using discs results from the elimination of eddy currents in the oil, which would interfere with the passage of the moisture and sediment in the oil from the center to the circumference of the bowl.

The bowl is supported and driven by a vertical shaft, running up through the frame of the machine. Proper multiplication of speed is obtained by means

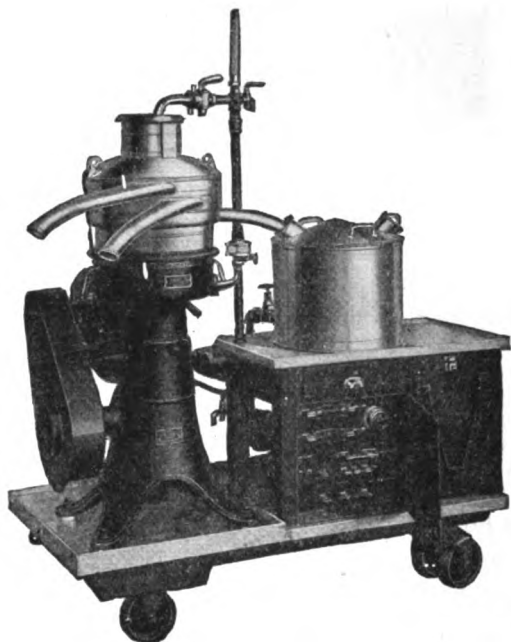


FIG. 2—PORTABLE TRANSFORMER-OIL PURIFIER OUTFIT

pounds pressure. The maximum allowable pressure is 125 pounds.

### Construction

The centrifugal transformer oil purifiers are made in two sizes and are arranged for stationary or

DE LAVAL TRANSFORMER OIL PURIFIERS AND DEHYDRATORS—Continued

of an approved type of worm wheel gearing placed within the base of the machine. Lubrication of all parts is automatically taken care of by means of a lubricator at the top of the frame and an oil reservoir in the base.

**Apparatus**

For service in the central station, the standard unit may be connected directly with the transformers by means of piping, in which case the necessary auxiliary equipment, such as pumps, heaters, etc., must be purchased by the user as extras. For other services, a portable unit mounted on a small truck, together with all the equipment needed to handle the oil, is supplied. This complete unit is easily moved from one transformer to another in the central station, or to isolated substation transformers, and after it is placed in position it is necessary to make only the two oil connections and one electrical connection before the circulation of oil is begun.

The equipment furnished with the portable unit includes the following:—

**Pumps**—Double-acting, geared rotary pumps to lift oil from the bottom of the transformer to the top of the purifier and to force it from the collecting tank into which it is discharged from the machine, back into the top of the transformer. With reduced discharge nozzles, these pumps are capable of developing about 60 pounds pressure which will appreciably increase the washing action of oil over the coils in the transformer.

**Strainer**—On the suction side of the pump is a small strainer to keep out any fairly large pieces of foreign matter which may be in the oil.

**Heater**—A 1500 to 6000-watt, bayonet type immersion heater, capable of raising the temperature

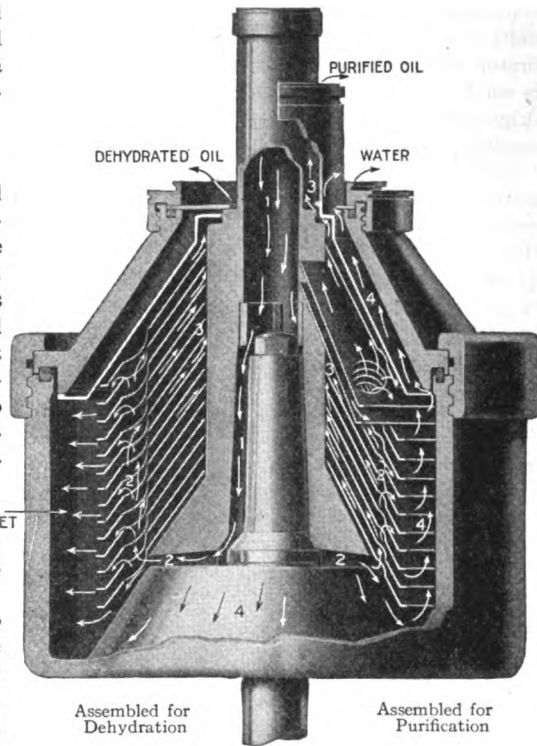


FIG. 3—CROSS-SECTION OF THE DUAL-PURPOSE OIL PURIFIER BOWL

of the oil to the required 50 degrees Centigrade under ordinary weather conditions is furnished.

**Thermometer**—A thermometer indicating temperatures up to 100 degrees Centigrade is inserted in the oil line through the machine intake.

**PRICES**

**De Laval Oil Purifiers**

The term "standard" in the following price list denotes the Transformer Oil Purifier as supplied for stationary service without any of the auxiliaries needed in its operation, except as noted. The term "portable" denotes the complete Transformer Oil Purifying Outfit, as described under the heading "Apparatus."

In ordering specify phase, frequency and voltage of the operating circuit. Heaters furnished with portable outfits can be supplied for but one voltage.

Style No.	Trade No.	Description	WEIGHT POUNDS		List Price
			Net	Shipping	
359805	300† Standard	Belt-driven . . . . .	340	430	\$1150 00
359806	301† Standard	Turbine-driven . . . . .	290	375	1150 00
359807*	300† Standard	With standard motor equipment . . . . .	441	560	1420 00
359808†	300† Standard	With special motor equipment . . . . .	441	560	1470 00
359809	600‡ Standard	Belt-driven . . . . .	590	763	2200 00
359810	601‡ Standard	Turbine-driven . . . . .	590	763	2200 00
359811*	600‡ Standard	With standard motor equipment . . . . .	740	943	2600 00
359812†	600‡ Standard	With special motor equipment . . . . .	740	943	2675 00
359813	300† Portable	With standard equipment . . . . .	950	1150	2220 00
359814	600‡ Portable	With standard equipment . . . . .	1250	1450	3500 00

\*Standard motors are 110, 220-volt direct-current. 110, 220, 440, 550-volt, 2 or 3-phase—60 cycles, alternating current.  
 †Special motors are 550-volt direct-current, all single-phase and all frequencies other than 60 cycles, alternating current.  
 ‡Small machine.  
 §Large machine.

DE LAVAL TRANSFORMER OIL PURIFIERS AND DEHYDRATORS—Continued

OUTLINE DIMENSIONS

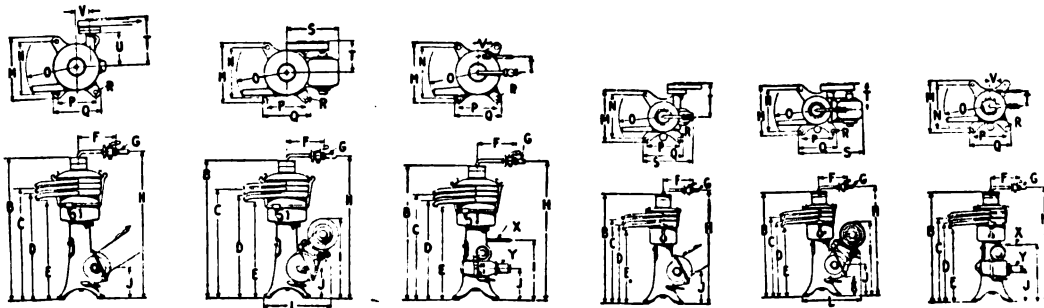


FIG. 4 FIG. 5 FIG. 6 FIG. 7 FIG. 8 FIG. 9

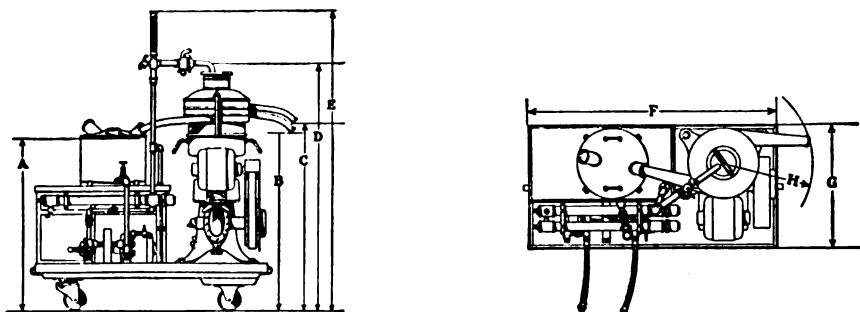


FIG. 10

Style No.	Fig. No.	DIMENSIONS IN INCHES											
		A	B	C	D	E	F	G	H	I	J	K	L
359605	7	....	40 1/4	29 3/4	27 3/4	25 3/4	10 3/4	1	42 1/4	....	11 1/4	..	....
359606	9	....	40 1/2	29 1/2	27 1/2	25 1/2	10 3/4	1	42 1/2	22 3/4	12	..	....
359607	8	....	40 1/4	29 1/4	27 1/4	25 1/4	10 3/4	1	42 1/4	30	11 1/4	6	22 1/2
359608	8	....	40 1/4	29 1/4	27 1/4	25 1/4	10 3/4	1	42 1/4	30	11 1/4	6	22 1/2
359609	4	....	50	36 3/4	34 3/4	33 3/4	11 1/4	1	52 1/2	....	12 1/2	..	....
359610	6	....	50	36 3/4	33 3/4	34 3/4	11 1/4	1	52 1/2	24 3/4	12 1/2	..	....
359611	5	....	50	36 3/4	34 3/4	33 3/4	11 1/4	1	52 1/2	32	12 1/2	..	25 1/4
359612	5	....	50	36 3/4	34 3/4	33 3/4	11 1/4	1	52 1/2	32	12 1/2	..	25 1/4
359613	10	....	37 1/4	39 1/4	41 1/4	53 1/4	66 3/4	60	16 1/4	....	....	..	....
359614	10	....	45 1/4	46 1/4	48 1/4	64	77	60	20 3/4	....	....	..	....

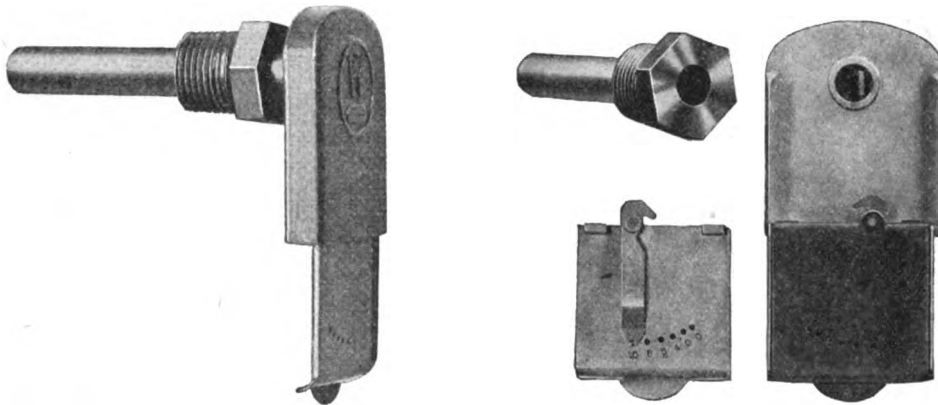
  

Style No.	Fig. No.	DIMENSIONS IN INCHES											
		M	N	O	P	Q	R	S	T	U	V	X*	Y†
359605	7	18 1/2	15 3/4	16 3/4	12	14 3/4	☆	18 1/4	14 3/4	....	....	..	....
359606	9	18 1/2	15 3/4	17 1/4	12	14 3/4	☆	....	5 3/4	....	2 1/4	3/8	2 1/2
359607	8	18 1/2	15 3/4	17 1/4	12	14 3/4	☆	25	10	....	....	..	....
359608	8	18 1/2	15 3/4	17 1/4	12	14 3/4	☆	25	10	....	....	..	....
359609	4	21 1/2	18 1/4	21 3/4	14	17	☆	....	17	11 1/4	5 1/4	..	....
359610	6	21 1/2	18 1/4	21 3/4	14	17	☆	....	5 3/4	....	2 1/4	3/8	3
359611	5	21 1/2	18 1/4	21 3/4	14	17	☆	19 1/2	12 1/4	....	....	..	....
359612	5	21 1/2	18 1/4	21 3/4	14	17	☆	19 1/2	12 1/4	....	....	..	....
359613	10	....	....	....	....	....	....	....	....	....	....	..	....
359614	10	....	....	....	....	....	....	....	....	....	....	..	....

\*Steam inlet.  
†Exhaust outlet.

Order by Style Number

## TRANSFORMER LOAD INDICATOR



**Application**—The Westinghouse transformer load indicator is a device arranged for mounting in place of the drain plug or preferably in the side of the tank wall a few inches below the oil level in a distribution transformer for the purpose of indicating whether any pre-determined temperature of the transformer has been reached or exceeded. It is so constructed that when this pre-determined temperature has been reached, a yellow flag, or semaphore, drops into view to give a visible indication of the fact.

Several applications can be made of this device, the most important being to indicate when a transformer is overloaded and should be changed. Another use is in determining whether transformers operating in a bank or in parallel are properly dividing the load. The device can also be used to

obtain more efficient loading of transformers, since underloaded units can be detected by setting the indicator to trip at a low temperature. Failure to trip with the low setting is an indication that the transformer is underloaded.

**Calibration**—The indicator can be set to trip the semaphore at any pre-determined temperature within the range of adjustment, by setting the trigger according to the following table of approximate temperatures:

Trigger Setting	0	2	4	6	8	10
Approximate Tripping Temperature degrees Centigrade	50	60	70	80	90	100

### INSTRUCTIONS FOR ORDERING

Style number and list price include indicator complete with plug. The standard carton contains twelve (12) transformer temperature indicators and it is preferable that they be ordered in quantities of a standard carton or multiple of it. The temperature indicator is made with two sizes of plugs. Style No. 311735 has a 1/2-inch plug, and Style No. 320927 has a 3/4-inch plug. These two style numbers differ only in respect to the diameter of the plug. These plugs will fit the majority of transformers, as can be seen from the following tabulation showing the sizes of the drain plugs used with the 2300-volt type S transformer.

Kv-a.	Size of Plug Standard Pipe Thread	Kv-a.	Size of Plug Standard Pipe Thread
1.5	1/2 inch	37.5	3/4 inch
3	1/2 inch	50	3/4 inch
5	1/2 inch	75	3/4 inch
7.5	3/4 inch	100	3/4 inch
10	3/4 inch	150	1 1/2 inch
15	3/4 inch	200	1 1/2 inch
25	3/4 inch		

If the drain outlet of the transformer is larger than 3/4-inch standard pipe thread, which is the thread on the indicator plug, the proper pipe bushing should be added to the indicator plug to adapt it to the transformer drain outlet.

#### Indicator Complete with Plug

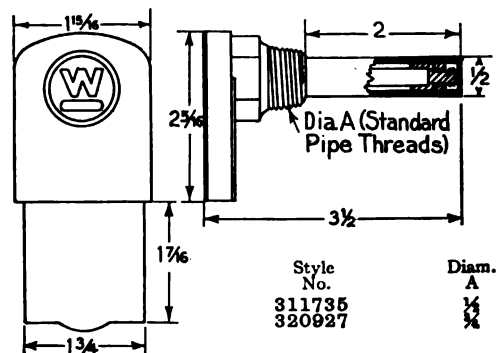
Style No.	Size of Plug Standard Pipe Thread	APPROX. WT. IN LBS.		List Price Each
		Net Each	Shipping Carton (12)	
311735	1/2 inch	1 1/2	8	\$4 00
320927	3/4 inch	1 1/2	8	4 00

#### Plug without Indicator

358988	1/2 inch	1/4	4	1 00
358989	3/4 inch	1/4	4	1 00

#### Indicator without Plug

363217	....	1/4	4	3 00
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## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS FOR INDOOR MOUNTING

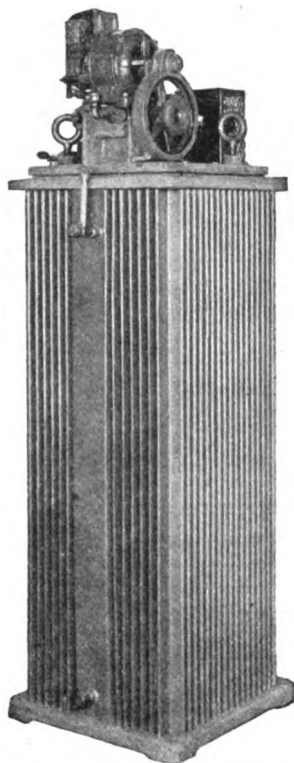


FIG. 1—TYPE C MOTOR-OPERATED SINGLE-PHASE INDUCTION REGULATOR, COMPLETE

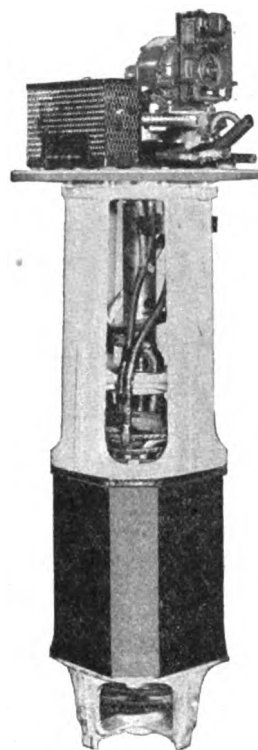


FIG. 2—TYPE C, MOTOR-OPERATED SINGLE-PHASE INDUCTION REGULATOR, REMOVED FROM TANK

Westinghouse type C induction feeder-voltage regulators are built both single-phase and poly-phase and are used for maintaining constant normal voltage on each feeder of a transmission or distribution system, independently of all other feeders on the system. They are also finding economical use for feeder circuits on which it is desirable to increase the normal load, it being less expensive in many cases to install a regulator to obtain normal voltage under the new load conditions rather than to install a heavier feeder.

### Operation

Induction feeder regulators operate on the transformer principle and in construction are very similar to an induction motor. The stationary or stator winding is connected in series with the feeder circuit, while the primary or rotor winding is connected in shunt to the feeder circuit and supplies the excitation for the regulator.

Regulation of the feeder voltage is accomplished by turning the rotor, either by hand or electrically,

so as to change the relation of the rotor winding to the stator winding. Regulation is smooth and gradual in either direction throughout the entire range of the regulator. The circuit is not opened at any point, the effect of the regulator being practically the same as would be obtained by changing the generator voltage.

**Theory of Operation of Single-Phase Regulator—**The single-phase regulator is in effect a two-winding transformer, with the secondary winding arranged for connection in series and the primary winding arranged for connection directly across the line. With a transformer thus connected a voltage will be induced in the secondary that will add to or subtract from the feeder voltage according to the connections used.

With the regulator, the primary winding is the movable winding (see Fig. 4), and the secondary, the stationary winding (see Fig. 5). Now, as with a transformer, the current in the primary produces a magnetic field that induces a voltage in the secondary. The portion of this

## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

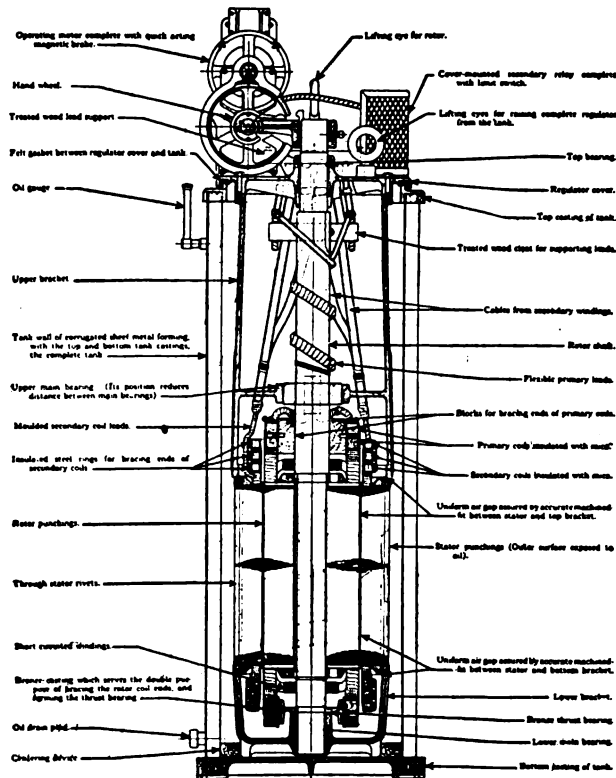


FIG. 3—DETAILS OF CONSTRUCTION—MOTOR-OPERATED SINGLE-PHASE TYPE C INDUCTION FEEDER-VOLTAGE REGULATOR FOR 23 KV-A. AND ABOVE

field passing through the secondary winding, and consequently the voltage induced in that winding, depends upon the angular position of the secondary with respect to the direction of the primary field. The induced voltage is a maximum when the axes of the coils coincide; zero when the coils are at right angles to each other; and maximum in the opposite direction when the axes of the coils coincide but with primary coils reversed in position.—This induced voltage in the secondary therefore adds to or subtracts from the feeder voltage by a value varying from maximum regulation, to zero, according to the position of the coils.

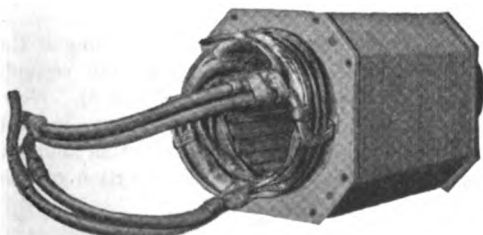


FIG. 5—SINGLE-PHASE STATOR (SECONDARY)

It is evident that a magnetic field is also set up by the line current flowing through the secondary windings (stator coils) which, if not neutralized, would produce a choking effect and lower the power



FIG. 4—SINGLE-PHASE ROTOR (PRIMARY)

factor in the feeder circuit. This choking effect would occur whenever the primary winding (rotor) is in any position other than where the axes of the two windings coincide—the positions of maximum "buck" or "boost"—being minimum near these positions and maximum when the axes of the two windings are at right angles to each other—the neutral positions. To overcome this choking effect, a short-circuited winding is placed on the rotor core at right angles to the primary coils; this short-circuited winding acts as a secondary to the stator coils and neutralizes their choking effect. By using a large number of turns of relatively small insulated wire in the short-circuited winding, the choking effect is neutralized with a comparatively small copper loss in the short-circuited winding.

## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

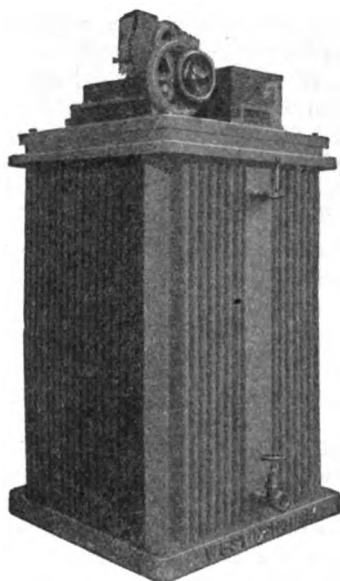


FIG. 6—THREE-PHASE O. I. S. C. MOTOR-OPERATED REGULATOR



FIG. 7—SINGLE-PHASE REGULATOR WITH AUTOMATIC ACCESSORIES MOUNTED ON A PANEL

#### Theory of Operation of Polyphase Regulator—

The polyphase regulator may be likened somewhat to a phase-wound polyphase motor. The regulator primary is wound with a distributed winding of the same number of phases as there are phases in the feeder to be regulated and each phase is connected across a separate phase of the feeder. The regulator secondary is made up of separate windings of the same number as the primary, and each of these separate windings is connected in series with one of the feeder wires.

The primary sets up a rotating magnetic flux of constant value, which induces a constant voltage in each of the secondary windings. The induced voltage is therefore added vectorially to the feeder voltage and accordingly the feeder voltage is changed by an amount of the induced voltage proportional to the cosine of the phase angle between the feeder and regulator voltages, which is the same as the angle between windings. As the position of the rotor is changed, the phase angle between the feeder voltage and the secondary voltage correspondingly changes, and the feeder voltage is either increased or decreased as the phase angle is less or greater than 90 degrees.

Since the polyphase regulator has windings distributed around the entire circumference of the primary, these windings will also act as neutralizing windings for the various secondary windings and no separate short-circuited windings, as in the case of single-phase regulators, are necessary.

**Motor-Operated**—In the standard regulators, the rotor is turned by a small alternating-current induction motor driven through a pinion, spur gear, worm, and worm segment. The motor is controlled

non-automatically by a hand-operated switch, or by an electrically-operated switch with push-button control mounted in any convenient location; or automatically by means of relays and other accessories especially made for the service. The motor-operated regulators are equipped with a hand wheel to operate them by hand in case of failure of the control circuit.

**Hand-Operated**—Regulators that are operated by hand can be supplied only on special order. For these a suitable hand wheel is supplied. This wheel may be connected directly to the worm shaft or mounted separately from the regulator and arranged to operate it by means of a chain and sprockets.

**Insulation Test**—Standard Westinghouse induction feeder voltage regulators are subjected to insulation test as specified in A. I. E. E. rules. All 2300-volt single-phase regulators are subjected to an insulation test of 7500 volts for one minute between iron and winding, so that they may be used on 4000-volt three-phase four-wire grounded circuits.

#### Construction

Mechanical construction and design have been given special attention in Westinghouse induction feeder-voltage regulators, as these are important characteristics that largely determine the satisfactory operation, minimum maintenance expense, and durability of feeder regulators.

The important feature to be noted is the additional bearing which has been introduced in the upper bracket. The introduction of this bearing which is a patented feature, constitutes a marked improvement in regulator design. Note the following:

The machine is more rugged, as the distance between bearings is lessened.

## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

The floor space has been reduced and the height increased without weakening the rotor construction.

A better alignment of the bearings is obtained as both bracket surfaces and upper and lower bearings can be machined in one operation without reversing the casting.

With the old two-bearing construction, it is necessary in machining the upper bracket, to turn one face and then to reverse the bracket. With this process there is an added difficulty in keeping the bearings accurately in line. If the bearings are not accurately in line the air gap will be non-uniform, causing vibration, noise and deterioration.

**Insulation**—Regulators operate in most cases under severe conditions of voltage and mechanical strain on the insulation of the coils. Unlike most other types of station apparatus, the regulator passes the entire load on the feeder through its secondary winding and often has no protection other than the oil circuit-breaker between the regulator and the station bus. It is therefore subject to voltage strains from surges, static, or other line disturbances; and the secondary coils receive the mechanical shock resulting from heavy current rushes due to short circuits on the feeder. These rushes of current may reach excessive values and result in violent

mechanical forces in the windings, tending to distort the coils and injure the insulation.

Because of the severe service conditions the coils of Westinghouse feeder regulators are carefully insulated. There is a mica cell in all the slots and mica between turns of all secondary coils of from two to six turns, which includes single-phase machines of 23 kv-a. and larger.

Special care is taken to secure mechanical strength to resist bending or twisting of the coil ends by placing rings formed from rectangular steel rod, taped and impregnated, over the ends of the secondary windings. (See Fig. 5.)

The method employed for bracing the rotor coils is to place a block between the coil ends and the shaft in such a manner that the bearing surface between each coil end and the bracing block is as great as possible. Under the worst conditions where the regulators are installed near large generators and a destructive short circuit occurs near the regulator, even these special coil supports may not provide sufficient protection for the windings, and current limiting reactances should be provided to prevent this current from exceeding 25 times full load.

## ACCESSORIES FOR MOTOR-OPERATED REGULATORS, AUTOMATIC AND NON-AUTOMATIC OPERATION

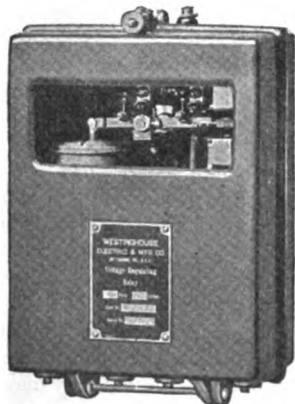
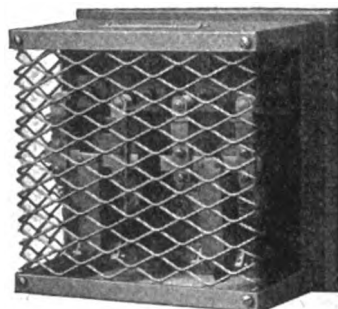


FIG. 8—PRIMARY RELAY

**Operating Motor**

Standard regulators, single-phase or three-phase, are equipped with either two-phase or three-phase 230-volt 60-cycle operating motors. Two-phase motors are provided with three terminals for use on a two-phase three-wire circuit only. If the voltage of the motor control circuit is other than 230 volts, transformers are necessary (see below).

**Single-Phase Motors**—On special order small capacity,  $5\frac{3}{4}$  to 23 Kv-a. single-phase regulators can be supplied with 230-volt 60-cycle single-phase motors for use where a polyphase control circuit is not available; but single-phase motors are in general less satisfactory than polyphase motors for regulator service, and are therefore not recommended for use

FIG. 9—SEPARATE-MOUNTING  
SECONDARY RELAY

except in special cases where a polyphase control circuit cannot be provided.

Single-phase motors are not furnished for poly-phase regulators.

**Transformers for Control Circuit**

**For Voltages Higher than 230**—When a 230-volt control circuit is not available, transformers must be used for providing this voltage. For each standard two or three-phase operating motor two 1-kilovoltampere distribution transformers of suitable primary voltage and 230-volt secondary are recommended; and for each single-phase operating motor (on special order) one 1-kilovoltampere transformer of similar voltage ratings. Where a number of

## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

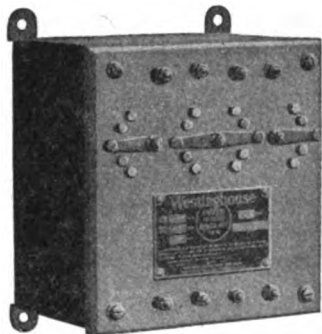


FIG. 10—TYPE KC COMPENSATOR

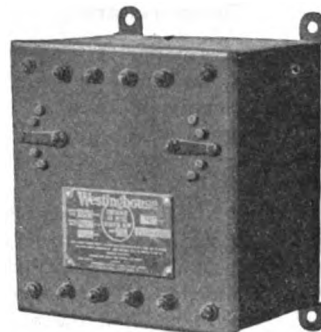


FIG. 11—TYPE KA COMPENSATOR

regulators are installed in the same station, one set of transformers is usually sufficient; the capacity of this set can be somewhat lower than the sum of the capacities that would be required of individual sets of transformers.

For description and prices of suitable distribution transformers, refer to section 4-A.

**For 115-Volt Circuits**—When a 115-volt 60-cycle two- or three-phase circuit is available, two (per regulator) auto-transformers, Style No. 151686 can be supplied to transform from 115 to 230 volts. These auto-transformers are listed on a following page under "Accessories Furnished Separately."

#### Secondary Relays

A relay switch is used to control the motor circuit so as to relieve the contacts of the primary relay from the necessity of carrying the current required to operate the motor. On the Westinghouse regulators this relay switch, called the secondary relay, is operated by the control circuit closed through a primary relay when automatically operated or through a hand-operated switch when non-automatically operated—a push-button switch generally is used. It is essentially an electrically-operated double-pole double-throw switch.

The metal contacts of this relay are of the butt-type, mounted on springs. All parts are enclosed in an expanded metal cover with closed top that protects them mechanically while permitting ready inspection. The standard secondary relay requires a 230-volt 60-cycle operating circuit.

A secondary relay is mounted directly on the regulator cover (see Fig. 2) of all standard single-phase and three-phase motor-operated regulators. Special regulators of larger frames than those listed herein sometimes have the secondary relay arranged for separate mounting (see Fig. 9). Non-automatic regulators can be supplied on special order without the secondary relay, but with a limit switch, only, mounted on the cover.

A **limit switch**, connected in the operating circuit and actuated by the operating mechanism of the regulator, prevents overtravel of the rotor in either direction. It is combined with the secondary relay

when that relay is mounted on the regulator cover (see above); and when the secondary relay is mounted separately the limit switch is mounted directly on the regulator cover.

#### Primary Relay

The **voltage-regulating relay** is in effect a voltmeter having two sets of contacts that control the two circuits operating the secondary relay.

The standard primary relay (see Fig. 8) is enclosed in a metal case with dustproof cover provided with a window permitting ready inspection of the operating parts. It has compounding coils so that as soon as a change in voltage causes either set of contacts to close they do not "chatter" but remain closed until the voltage returns to normal. Means are provided for adjusting the relay for different voltage variations and ranges.

The standard primary relay may be adjusted to operate from 90 to 140 volts (110 volts normal); a voltage transformer is necessary to reduce the voltage of the feeder circuit to relay voltage.

**No-Voltage Device**—The primary relay is equipped with a no-voltage device which operates to cause the regulator rotor to be turned to the position of minimum voltage in case the power supply in the feeder circuit is interrupted. It therefore prevents the possibility of temporary overvoltage on the circuit when the power supply is again continued.

**Primary Relay Resistance**—When induction feeder regulators are situated at the load center or center of distribution it is not necessary to use a compensator to compensate for line drop. If the compensator is omitted it is necessary to furnish a primary relay resistance.

#### Voltage Transformer

A dry-type voltage transformer (see section 3-B on "Westinghouse Instruments and Relays") of the proper rating is used to reduce the feeder voltage to a value suitable for the primary relay. One transformer is required for each of single-phase, two-phase, or three-phase regulator.

TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

Compensators

A compensator is a device connected to the feeder circuit at the station by means of a current transformer, and, in connection with the voltage transformer, produces at the primary relay terminals a voltage proportional to that at the distributing end of the feeder.

The types KA and KC compensators are very compact. They consist of a slate panel containing the necessary terminals and dial switches, at the back of which are mounted the reactance and resistance elements. In addition the primary-relay resistance tubes are included in the compensator case, so that no external additional resistors are used. The individual feature of these compensators is that the primary relay resistance is made a part of the compensator so that it is not necessary to use additional resistance within the compensator to obtain the ohmic drop for compensating purposes. This method saves approximately 100 watts at full load which would otherwise be wasted in the compensator resistance. The coils and resistances are protected by a strong perforated metal case. The compensator complete is arranged for wall or switchboard mounting.

Type KA, Fig. 11, This compensator may be set to compensate for the voltage drop at any varying load of any constant power factor. The secondaries of the instrument transformers may be grounded. The type KA compensator will not, however, compensate correctly for a varying load at a variable

power factor (see type KC). Single and three-phase type KA compensators are furnished for use with single- and three-phase regulators respectively.

Type KC, Fig. 10, When necessary the type KC compensator will be substituted for the type KA without extra charge. The type KC has a resistance element and a reactance element and may be set to compensate correctly for a varying load at a variable power factor, and if desired the secondaries of the instrument transformers may be grounded.

Current Transformer

A type KA current transformer (see section 3-B on "Westinghouse Instruments and Relays") of the proper capacity is used for obtaining a value of the feeder current that is suitable for use with the compensator. For single-phase and two-phase regulators, one current transformer is used, and for a three-phase regulator and a three-phase compensator, two current transformers are required.

Two Single-Phase Regulators, Regulating a Three-Phase Three-Wire Circuit

If two standard single-phase regulators are used to regulate a 2300-volt three-phase circuit three-phase compensators should be used, and three current transformers. A bank of two regulators, therefore, operating on a three-phase circuit requires two three-phase compensators and three current transformers. The price on the extra current transformer can be obtained from the section on "Instruments and Relays".

PRICES

STANDARD REGULATORS OIL INSULATED SELF-COOLED FOR 60-CYCLE 2300-VOLT CIRCUITS

Indoor Mounting

Regulator Capacity Kv-a.	Feeder Capacity Amperes	Per Cent Regulation†	Frame No.	Gallons Oil	APPROX. WT.		STYLE NO. MOTOR-OPERATED REGULATOR WITH		LIST PRICE MOTOR-OPERATED	
					Net* Lbs.	Shipping†	Two-Phase Motor	Three-Phase Motor	Non-Auto-matic	Auto-matic
<b>For Single-Phase Circuits</b>										
5½	{ 25 50	{ 10 5	4E	42	1000	1450	307499	307490	\$640 00	\$800 00
11½	{ 50 100	{ 10 5	4D	45	1100	1650	307500	307491	700 00	860 00
17½	{ 75 150	{ 10 5	4C	40	1400	1900	307501	307492	820 00	980 00
23	{ 100 200	{ 10 5	4A	45	1600	2200	307502	307493	920 00	1080 00
34½	{ 150 300	{ 10 5	4L	60	2040	2800	307503	307494	1090 00	1250 00
46	{ 200 400	{ 10 5	8D	75	2500	3400	307504	307495	1350 00	1510 00
57½	{ 125 250	{ 20 10	10A	95	3000	4100	307505	307496	1800 00	1760 00
69	{ 150 300	{ 20 10	13A	160	4000	5800	307506	307497	1990 00	2150 00
92	{ 200 400	{ 20 10	13E	170	4500	6400	307507	331695	2615 00	2650 00
<b>For Three-Phase Circuits</b>										
10	25	10	12D	73	1945	2800	.....	301592	1155 00	1340 00
20	50	10	12A	85	2600	3400	.....	301593	1435 00	1620 00
30	75	10	12A	85	2800	3800	.....	301594	1675 00	1860 00
40	100	10	12B	90	2900	4000	.....	301595	2090 00	2275 00
60	150	10	14A	160	5030	6800	.....	279453	3465 00	3650 00
80	200	10	16A	230	6000	8400	.....	279454	3840 00	3925 00
100	250	10	16B	280	6400	9200	.....	279455	3365 00	3550 00
120	300	10	18C	370	7300	11000	.....	331696	3715 00	3900 00

\*Net weight includes regulator without oil or accessories for automatic operation. Net weight of oil is approximately 7½ pounds per gallon.

†Shipping weight includes regulator and necessary oil but does not include shipping weight of accessories for automatic operation. Automatic accessories for single-phase regulators weigh approximately 135 pounds; for three-phase regulators up to 40 kv-a., 180 pounds; and for three-phase regulators 60 to 100 kv-a., 200 pounds.

‡Percentage that regulator will add to and take from feeder voltage.

The automatic accessories, with the exception of the current and voltage transformers, may be mounted on a panel as shown in Fig. 7 at an increase in list price of \$63.00 per regulator.

## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

## INSTRUCTIONS FOR ORDERING

## Apparatus Included in Style Number and List Price

## (Indoor)

## Non-Automatic Motor-Operated

**Style number of the non-automatic regulator includes regulator complete with a 230-volt 60-cycle two-phase or three-phase operating motor as listed; all standard regulators have a 230-volt secondary relay and limit switch contained in one case mounted on top of the regulator. Style number of regulator**

does not include any other accessories than above stated.

**List price** includes regulator as described in the previous paragraph complete with the necessary quantity of oil.

## Automatic Motor-Operated

**Style Number** of regulator is the same as that of the non-automatic regulator. In addition to the regulator, the following accessories must be ordered for standard automatic operation:

**List Price** includes non-automatic motor-operated regulator with oil and the following accessories for automatic operation:

Quantity	Style No.	Description
1	238610	Primary Relay. (With No-Voltage Device—110 volts, 25 to 133 cycles or 110 volts d.c.)
1	303914	Voltage Transformer, (60-cycles, 2300 volts primary, 115 volts secondary.)
1 (for single-phase regulator.) 2 (for three-phase regulator.)	For style number of current transformers of proper rating refer to catalogue Section 3-B.	Type KA Current Transformer with same primary current rating as feeder and five-ampere secondary.
1	325035 or 307112 or 325036 or 307113	Type KA Compensator, single-phase, 20 per cent compensation. (For use on circuits of steady power factor or on circuits for which only ohmic line-drop compensation is required.) Type KC Compensator, single-phase, 20 per cent compensation. (For use on circuits of varying power factor.) Type KA Compensator, three-phase, 20 per cent compensation. (For use on circuits of steady power factor or on circuits for which only ohmic line drop compensation is required.) Type KC Compensator, three-phase, 20 per cent compensation. (For use on circuits of varying power-factor.)

## Specify on Order as Separate Items

**Regulator**—Give style number, capacity, voltage, and per cent regulation. State whether the regulator is to operate on a single-phase circuit; three-phase, 2300-volt, three-wire circuit; or three-phase, 4000-volt four-wire circuit.

**Oil**—Specify the gallons of Wemco A oil required (total for all regulators on order). The quantity required for each regulator is given in tables.

**If Automatic Regulator is Wanted:**

**Accessories** that are required as specified under

heading "Apparatus Included in Style Number and Price—Automatic Motor-Operated." (Order each by style number.)

**Primary Relay Resistor** Style No. 334366 must be specified if compensator is omitted entirely.

**Distribution Transformer**, see section on "Distribution Transformers" or **Auto-Transformer, Style 151686**—(See information on "Transformers for Control Circuit" on a previous page.)

TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued  
**SPECIAL REGULATORS**

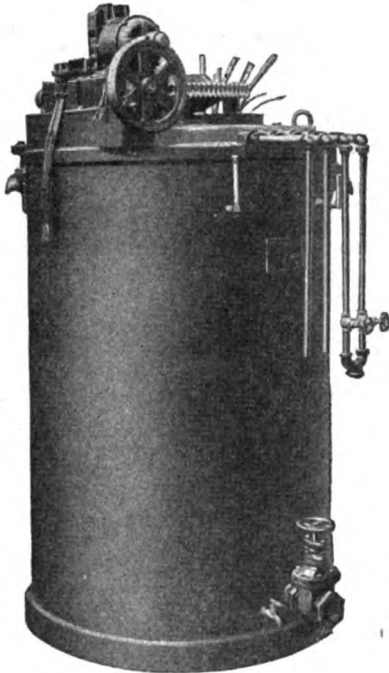


FIG. 12—THREE-PHASE O. I. W. C. MOTOR-OPERATED REGULATOR

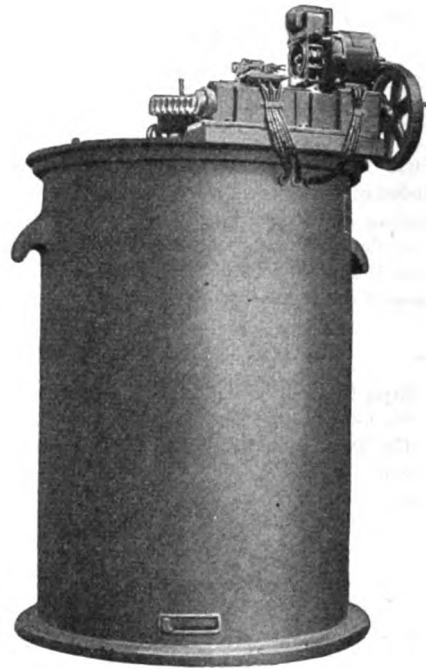


FIG. 13—THREE-PHASE AIR-BLAST MOTOR-OPERATED REGULATOR

In addition to the standard regulators listed above, regulators of the following characteristics can be supplied on special order, prices on request.

**Larger-capacity Regulators**—than those listed above.

**Other Voltages**—Regulators for operation on feeders of other voltages than those listed above.

**Two-Phase Regulators**—Two single-phase regula-

tors with one operating motor on an operating shaft common to both regulators, can also be supplied for two-phase operation.

**Other Frequencies**—Regulators for operation on frequencies other than listed above.

**Hand-Operated regulators.**

**Air-Blast Cooled Regulators** (See Fig. 13).

**Water-Cooled Regulators** (See Fig. 12).

### OUTDOOR TYPE FOR PLATFORM MOUNTING

The outdoor type C induction feeder-voltage regulators provide a means of obtaining good voltage regulation in outlying districts or on any other part of an alternating-current distribution system without the expense of housing—they fit in well with the other apparatus now being used so economically in outdoor substations and other outdoor installations.

Being entirely weatherproof and self-contained, these regulators may be mounted on the ground, or on a platform constructed between poles, in the same manner as transformers in outdoor substations. The only attention required is a general inspection at regular intervals for oiling the motor bearings and worm-screw mechanism, filling grease cups, and examining the relay contacts.

#### CONSTRUCTION

The outdoor induction regulator consists of a

standard type C indoor regulator described on the first pages of this section, modified for outdoor service.

A sheet steel housing is securely mounted on the top of the regulator tank, completely enclosing the regulator cover on which, in addition to the operating motor, mechanism, and secondary relay, are also mounted the primary relay, relay resistors, and any other accessories required.

The sheet steel housing has a hinged cover to facilitate inspection of the apparatus it encloses. The housing is mounted on the regulator in such a way that it does not in any way interfere with the easy removal of the regulator from the tank.

Lifting lugs are provided on the sides of the housing for raising the regulator. As these regulators are not intended for suspension from cross arms, they are not provided with mounting lugs.



## TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

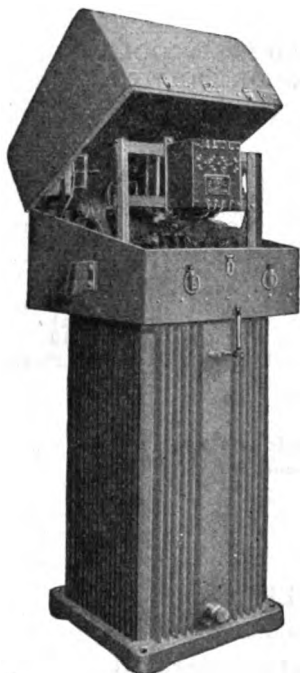


FIG. 14—OUTDOOR TYPE C REGULATOR

FIG. 15—OUTDOOR TYPE C REGULATOR  
(SHOWING ARRANGEMENT OF LEADS)

**Leads**—The leads for connecting the regulator to the line and for the control circuit are brought out of the housing, passing vertically downward through porcelain bushings, babbitted into the bottom flange of the housing, which extends horizontally beyond the regulator cover.

### ACCESSORIES

#### Operating Motor

As with the indoor regulators, a 230-volt 60-cycle two- or three-phase motor is standard and is recommended for these regulators; but if necessary on special order, 5 $\frac{1}{4}$  to 23 kv-a single-phase regulators can be supplied with 230-volt 60-cycle single-phase motors where a polyphase control circuit is not available (see pages of this section on indoor regulators).

#### Transformers for Control Circuit

The information regarding the control circuit for outdoor regulators is the same as that for indoor regulators described on the first pages of this section.

#### Accessories for Automatic Operation

The standard regulators for automatic operation include (see "Style Number and List Price Include") a primary relay and its resistors and a secondary relay, all mounted on the regulator cover and enclosed by the housing.

**Compensator and Current Transformer**—As it is expected that the regulator will be installed at the distributing center of the feeder circuit and will therefore not have to compensate for a voltage drop to a distant feeding point, but will have to correct for variable supply voltage only, the line-drop compensator and its accompanying current transformer are usually unnecessary and are not regularly supplied with the outdoor regulators. However, these can be had on special order at an increase in price. See "Prices."

**Voltage Transformer**—Usually 110 volts for the operation of the primary relay can be obtained from the distribution system controlled by the regulator, thus making the use of a separate voltage transformer unnecessary. In case 110 volts is not available, a voltage transformer can be furnished at an increase in price. See "Prices."

TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

**PRICES**  
**STANDARD REGULATORS, OIL-INSULATED SELF-COOLED**  
**FOR 60-CYCLE 2300-VOLT CIRCUITS OUTDOOR MOUNTING**

Regulator Capacity Kv-a.	Feeder Capacity Amperes	Per Cent Regulation†	Frame No.	Gallons Oil	APPROX. Net* Wt., Lbs.	Shipping‡	STYLE NO. AUTOMATIC MOTOR-OPERATED REGULATOR WITH		List Price
							Two-Phase Motor	Three-Phase Motor	
<b>For Single-Phase Circuits</b>									
5 3/4	25	10	4E	42	1150	1600	266988	266984	\$ 963 00
11 1/2	50	10	4D	45	1250	1800	266989	266985	1023 00
17 1/4	75	10	4C	40	1550	2100	266990	266986	1150 00
23	100	10	4A	45	1750	2300	266991	266987	1250 00
34 1/2	150	10	4L	60	2200	3000	370543	370538	1425 00
46	200	10	8D	75	2700	3600	370544	370539	1685 00
57 1/2	250	10	10A	95	3300	4300	370545	370540	1948 00
69	300	10	13A	160	4400	6100	370546	370541	2338 00
92	400	10	13E	170	4900	6700	370547	370542	2875 00

\*Net weight includes regulator without oil but with all accessories covered by style number. Weight of oil is approximately 7 1/2 pounds per gallon.  
 †Shipping weight includes regulator and necessary oil and weight of containers.  
 ‡Percentage that regulator will add to and take from feeder voltage.

**Additions to List Prices of Standard Outdoor Regulators**  
**For Adding Voltage and Current Transformers**

Description	List Price
Voltage Transformer.....	\$45 00
Current Transformer { 5 to 50 amperes.....	38 00
{ 75 to 100 amperes.....	41 00
{ 150 to 400 amperes.....	45 00

**INSTRUCTIONS FOR ORDERING**

**Apparatus Included in Style Number and List Price**  
**Outdoor Mounting Automatic Motor-Operated**

Style number of regulator includes regulator complete with housing, a 230-volt 60-cycle three-phase operating motor as listed, and the following accessories:

List price includes the regulator as described under style number with the necessary oil.

Quantity	Style No.	Description
1	238610	Primary Relay (With No-voltage Device—110 volts, 25 to 133 cycles or 110 volts d-c.)
1	236633	Secondary Relay (Including Limit-Switch).
1	334366	Primary Relay Resistance.
1	.....	3 P. S. T. Knife Switch with Fuses for Control Circuit.

Voltage transformer, current transformer, and line drop compensator are not included in style number or list price. For style number of the first two, see section on "Instruments and Relays;" for description of the line-drop compensators, see pages of this section on Indoor-Mounting Regulators. See preceding paragraph for prices.

**Specify on Order as Separate Items**

Regulator—Give style number, capacity, voltage, per cent regulation, and accessories required.

Oil—Specify the gallons of Wemco C oil required (total for all regulators on order). The quantity required for each regulator is given in tables.

**PRICES OF ACCESSORIES**

**Prices for Accessories Furnished Separately**

Description	Style No.	List Price*
Primary Relay..... Including No-voltage Device.....	238610	\$75 00
Secondary Relay..... { Separate Mounting.....	148029	40 00
	{ Cover Mounting.....	236633
Type KA Compensator..... { Single-Phase.....	325035	35 00
	{ Three-Phase.....	325036
Type KC Compensator..... { Single-Phase.....	307112	35 00
	{ Three-Phase.....	307113
Primary Relay Resistor.....	334366	11 00
Auto-Transformers to step up available 110-volt, 60-cycle two- or three-phase current to 220-volts for motor-control circuit.....	151686	20 00

For prices on Instrument Transformers, see Section 3-B. See "Instructions for Ordering."

**Deductions from List Prices of Standard Regulators for Omission of Accessories**

Description	Deduction from List Price* of Regulator
Primary Relay.....	\$75 00
Secondary Relay.....	40 00
Compensator { Single-Phase.....	35 00
	{ Three-Phase.....
Voltage Transformer.....	25 00
Current Transformer, Type KA, 25 to 400 Amperes.....	25 00

\*Regular discounts on Feeder Voltage Regulators applying.

Order by Style Number

TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

OUTLINE DIMENSIONS  
Standard Motor-Operated Regulators

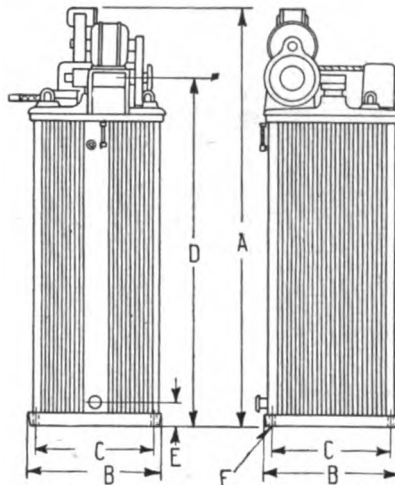


FIG. 16—INDOOR

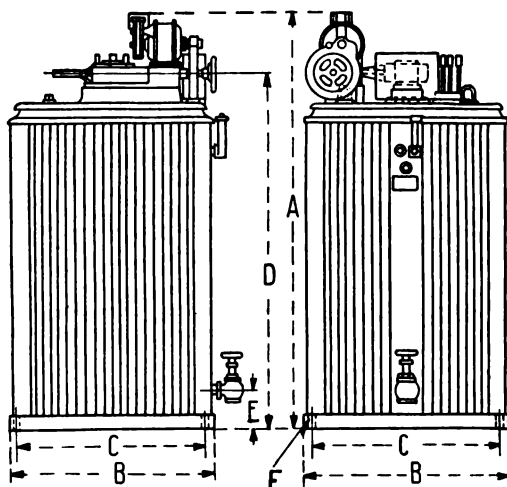


FIG. 17—OUTDOOR

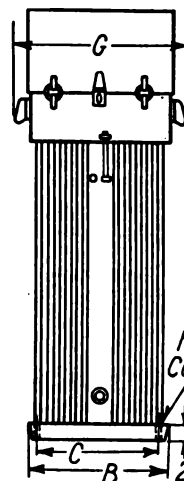
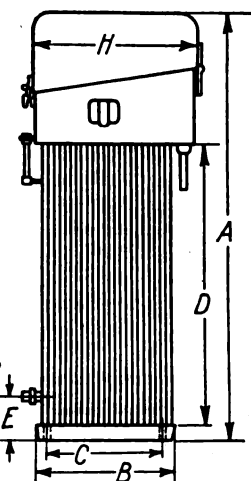


FIG. 18—OUTDOOR



Dimensions in Inches Corresponding to Letters in Outline View

Frame No.	Fig.	A	B	C	D	E	F	G	H
4-A	16	61 <sup>3</sup> / <sub>8</sub>	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	49 <sup>1</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	.....	.....
4-C	16	56 <sup>3</sup> / <sub>8</sub>	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	44 <sup>1</sup> / <sub>4</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	.....	.....
†4-D	16	53 <sup>3</sup> / <sub>8</sub>	19 <sup>1</sup> / <sub>2</sub>	*	40 <sup>5</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub>	*	.....	.....
†4-E	16	50 <sup>3</sup> / <sub>8</sub>	19 <sup>1</sup> / <sub>2</sub>	*	37 <sup>5</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub>	*	.....	.....
4-L	16	70 <sup>7</sup> / <sub>8</sub>	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	58 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	.....	.....
8-D	16	81 <sup>1</sup> / <sub>8</sub>	24 <sup>5</sup> / <sub>8</sub>	22 <sup>3</sup> / <sub>8</sub>	69 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	.....	.....
10-A	16	87 <sup>1</sup> / <sub>8</sub>	26 <sup>5</sup> / <sub>8</sub>	24 <sup>3</sup> / <sub>8</sub>	74 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	.....	.....
12-A	16	69 <sup>1</sup> / <sub>8</sub>	27 <sup>5</sup> / <sub>8</sub>	25 <sup>1</sup> / <sub>8</sub>	57 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
12-B	16	75 <sup>1</sup> / <sub>8</sub>	27 <sup>5</sup> / <sub>8</sub>	25 <sup>1</sup> / <sub>8</sub>	63 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
12-D	16	63 <sup>3</sup> / <sub>8</sub>	27 <sup>5</sup> / <sub>8</sub>	25 <sup>1</sup> / <sub>8</sub>	51 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
13-A	16	83	33	29 <sup>1</sup> / <sub>2</sub>	70 <sup>1</sup> / <sub>2</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
13-E	16	86	33	29 <sup>1</sup> / <sub>2</sub>	73 <sup>1</sup> / <sub>2</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
14-A	17	72 <sup>3</sup> / <sub>4</sub>	39 <sup>1</sup> / <sub>2</sub>	36 <sup>1</sup> / <sub>2</sub>	60 <sup>3</sup> / <sub>8</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
16-A	17	80 <sup>3</sup> / <sub>4</sub>	42 <sup>3</sup> / <sub>4</sub>	39 <sup>5</sup> / <sub>8</sub>	67 <sup>3</sup> / <sub>8</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
16-B	17	86 <sup>3</sup> / <sub>4</sub>	42 <sup>3</sup> / <sub>4</sub>	39 <sup>5</sup> / <sub>8</sub>	73 <sup>3</sup> / <sub>8</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
18-C	17	76 <sup>3</sup> / <sub>4</sub>	48 <sup>3</sup> / <sub>4</sub>	44 <sup>1</sup> / <sub>2</sub>	74 <sup>3</sup> / <sub>8</sub>	8 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	.....	.....
4-A	18	66 <sup>1</sup> / <sub>4</sub>	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	39 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	30 <sup>1</sup> / <sub>2</sub>	29 <sup>1</sup> / <sub>2</sub>
4-C	18	61 <sup>1</sup> / <sub>4</sub>	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	34 <sup>1</sup> / <sub>2</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	30 <sup>1</sup> / <sub>2</sub>	29 <sup>1</sup> / <sub>2</sub>
†4-D	18	56 <sup>3</sup> / <sub>8</sub>	19 <sup>1</sup> / <sub>2</sub>	*	33 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub>	*	32 <sup>1</sup> / <sub>2</sub>	23 <sup>5</sup> / <sub>8</sub>
†4-E	18	53 <sup>3</sup> / <sub>8</sub>	19 <sup>1</sup> / <sub>2</sub>	*	30 <sup>3</sup> / <sub>8</sub>	2 <sup>1</sup> / <sub>2</sub>	*	32 <sup>1</sup> / <sub>2</sub>	23 <sup>5</sup> / <sub>8</sub>
4-L	18	75	22 <sup>7</sup> / <sub>8</sub>	20 <sup>5</sup> / <sub>8</sub>	47 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	30 <sup>1</sup> / <sub>2</sub>	29 <sup>1</sup> / <sub>2</sub>
8-D	18	86	24 <sup>5</sup> / <sub>8</sub>	22 <sup>3</sup> / <sub>8</sub>	58 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	30 <sup>1</sup> / <sub>2</sub>	29 <sup>1</sup> / <sub>2</sub>
10-A	18	91 <sup>1</sup> / <sub>4</sub>	26 <sup>5</sup> / <sub>8</sub>	24 <sup>3</sup> / <sub>8</sub>	64 <sup>3</sup> / <sub>8</sub>	4 <sup>1</sup> / <sub>4</sub>	7 <sup>3</sup> / <sub>8</sub>	33 <sup>5</sup> / <sub>8</sub>	32 <sup>5</sup> / <sub>8</sub>
13-A	18	85 <sup>1</sup> / <sub>2</sub>	33	29 <sup>1</sup> / <sub>2</sub>	58 <sup>1</sup> / <sub>2</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	39 <sup>3</sup> / <sub>4</sub>	38 <sup>1</sup> / <sub>2</sub>
13-E	18	88 <sup>1</sup> / <sub>2</sub>	33	29 <sup>1</sup> / <sub>2</sub>	61 <sup>1</sup> / <sub>2</sub>	7 <sup>3</sup> / <sub>8</sub>	1 <sup>1</sup> / <sub>8</sub>	39 <sup>3</sup> / <sub>4</sub>	38 <sup>1</sup> / <sub>2</sub>

\*No holes in base.

†Tank walls are not corrugated.

The dimensions are for reference only. For official dimensions apply to nearest district office.

TYPE C INDUCTION FEEDER-VOLTAGE REGULATORS—Continued

AUXILIARIES

For Automatic Operation of Single-Phase and Polyphase Induction Regulators

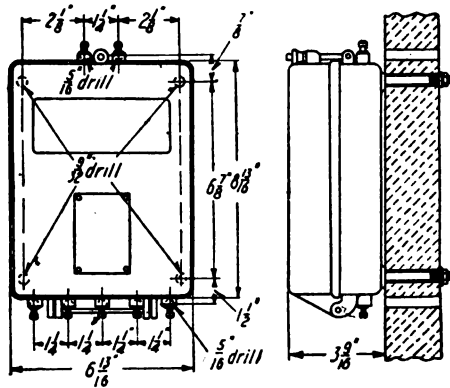


FIG. 19—PRIMARY RELAY

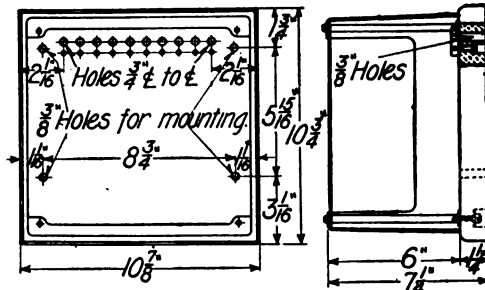


FIG. 20—SECONDARY RELAY, SEPARATELY MOUNTED

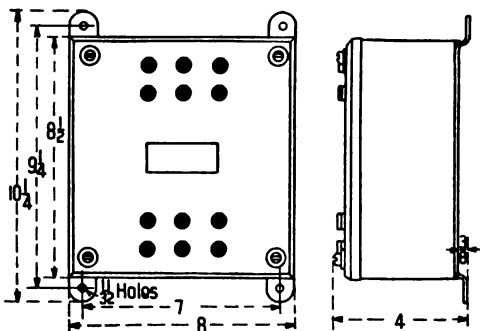


FIG. 21—RESISTANCE FOR PRIMARY RELAY

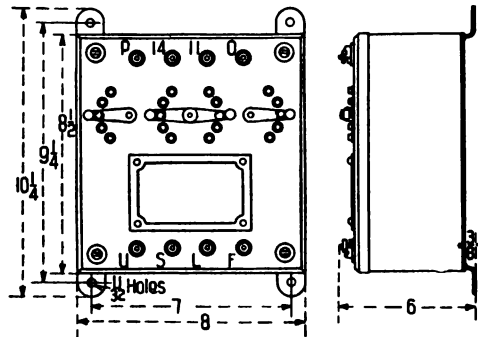


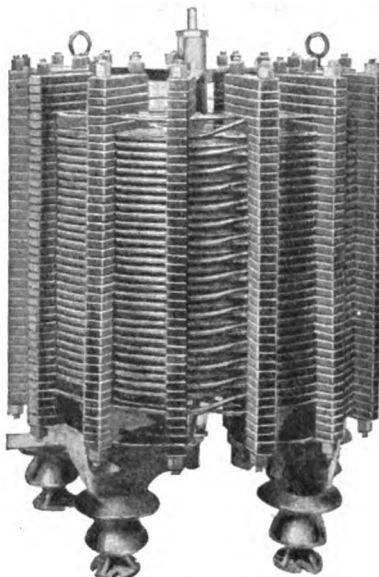
FIG. 22—TYPE KA OR KC COMPENSATOR  
(Resistance for primary relay is mounted in compensator case)

These dimensions are for reference only. For official dimensions apply to the nearest district office.

For dimensions of Voltage Transformers and Type KA Current Transformers see section on "Instruments and Relays."

## FEEDER REACTORS

For Use with Feeder Regulators



### Application

Westinghouse feeder reactors are built to meet the exacting conditions incident to the operation of modern large power systems. Feeder reactors are coils built to limit the amount of current that will flow in a feeder in case of short circuit. Prevention of heavy currents on short circuits will prevent the severe mechanical stresses in induction regulators and other apparatus connected to the feeder. Feeder regulators inherently have a very low reactance and where the feeder is connected to a system of large capacity, destructive currents may flow unless the amount of current is limited by external reactance.

This reactance should be sufficient to limit the current flow to twenty-five times the full-load rating of the regulator.

### Performance

These coils will be used in a group of three on a three-phase feeder, either 2300-volt, three-wire, or 2300/4000-volt, Y-connected, three-phase, four-wire. The temperature rise above the surrounding air measured by thermometer will not exceed 65° C. under the condition of full load continuously. The coils will withstand a short-circuit current of 25 times normal for a period of five seconds without dangerous rise of temperature. The coil will successfully withstand for one minute a voltage test of 10,000 volts applied between the coil and the base of its support.

### Windings

The winding consists of one or more stranded bare copper cables, the cables being connected in multiple

where necessary. The windings consist of disc-shaped layers wound radially so that the electrical stress between layers is very low. All cables have a symmetrical spacing and are wound in such a manner as to practically prevent circulating currents. The end turns of the winding are so spaced as to give additional insulation at the ends of the coil.

### Coil Supports

The cables are wound into grooves in specially prepared, moulded, non-inflammable supports. These supports have high insulating qualities and are capable of withstanding very high temperatures.

### Terminals

One end of the winding is brought to a terminal at the top and the other end to a terminal at the bottom of the coil. The terminals are usually located at the axis of the coil.

### Frame Work and Mounting

The supports are held together by means of heavy non-conducting rods which pass vertically through them. The rods are fastened at the top and bottom to non-magnetic castings which are arranged for bolting the insulating supports to them. The latter are of strong mechanical construction to resist the forces acting under short-circuit conditions. The insulator pins are suitable for bolting or cementing to the floor.

The construction of the coil has been demonstrated to be strong enough to withstand the severe electrical and mechanical stresses that occur at the time of a short circuit on a large system.

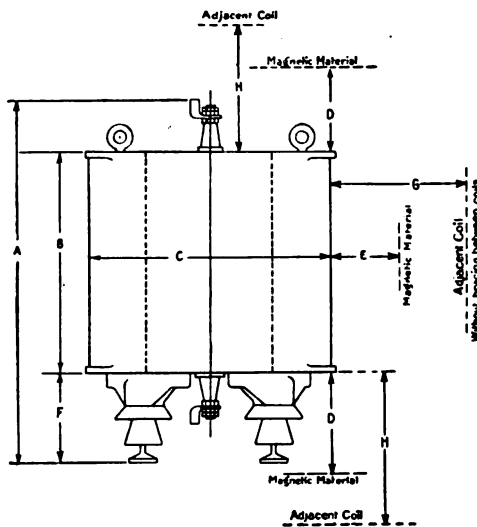
FEEDER REACTORS—Continued

PRICES

Standard Feeder Reactors for 60-Cycle, 4000-Volt Class  
Indoor Mounting

Feeder Capacity Amperes	Inductive Volts Drop	Dimension Reference	APPROXIMATE WEIGHT IN POUNDS		Style No.	List Price
			Net	Shipping		
100	46	1	325	400	383615	\$160 00
150	46	2	340	425	383616	165 00
200	46	3	360	450	383617	170 00
250	46	4	380	475	383618	175 00
300	46	5	400	500	383619	180 00
400	46	6	450	560	383620	190 00
100	69	7	400	500	383621	180 00
150	69	8	420	525	383622	190 00
200	69	9	440	550	383623	200 00
250	69	10	460	575	383624	210 00
300	69	11	480	600	383625	220 00
400	69	12	525	650	383626	240 00

OUTLINE DIMENSIONS IN INCHES



Dimension Reference	DIMENSIONS IN INCHES							
	A	B	C	D	E	F	G	H
1	23	14	26	11	7	5	11	17
2	25	16	26	11	7	5	11	17
3	25	16	26	11	7	5	11	17
4	25	16	26	11	7	5	11	17
5	26	17	26	11	7	5	11	17
6	29	20	26	11	7	5	11	17
7	26	17	26	11	7	5	11	17
8	26	17	26	11	7	5	11	17
9	27	18	26	11	7	5	11	17
10	27	18	26	11	7	5	11	17
11	29	20	26	11	7	5	11	17
12	33	24	26	11	7	5	11	17

The dimensions are for reference only. For official dimensions apply to nearest district office.

Order by Style Number

## MICARTA

**Micarta** is a substance developed by the research engineers of the Westinghouse Electric and Manufacturing Company, originally intended for insulation purposes. It has, however, since first developed, been put to a great number of other uses. Some idea of the variety of uses which has been found for Micarta is indicated by the rapid growth in the quantity and diversity of its sale.

**Applications**—Micarta is made in various grades in plates, tubes, and rods, all having the same general characteristics but differing in specific qualities which adapt them to different kinds of service. A few specific applications of Micarta are as follows:

### Plate Stock

Switchboards	}	Industrial motor pinions
Radio		Intermediate pinions
Gear stock . . . . .		Back gears
Couplings		Bevel gears and pinions
		Generator gears

Discs

Friction gears

Liners

Insulating bases

Punching material . . .

Spacing material

Panels

Pistons

}	Washers
	Telephone apparatus
	Cleats

### Tubing

Bus bar insulation

Conduits

Spools for spark coils and magnet windings

Radio apparatus

Brush holder insulation

Bushings

Transformer terminals

Entrance bushings.

### Rod

Spacers

Mandrels

Cores

Strain Insulators

Special attention is called to the application of No. 21-M Micarta in the manufacture of gears and pinions. The structural and wearing qualities of this grade of Micarta make it preferable to raw hide and other non-metallic materials which are used for gears and pinions where, because of noise, the use of metal gears or pinions is undesirable.

Its mechanical strength is so great that in most cases no metal end plates or bushings are required. These may be required to reinforce the keyway in case of heavy torque.

No. 21-M Micarta gears and pinions may safely be used in all kinds of service within the limit of strength of similar cast iron gears and pinions.

21-D Micarta is a good rail joint insulator.

**General Characteristics**—Micarta of all grades has high dielectric and mechanical strength. It is a hard, compact material which will not warp, expand, or shrink with age or with exposure to the weather. It takes a high polish and is accurate in thickness. It is infusible and remains unaffected by heat until a temperature is reached that is sufficiently high to carbonize the material (see paragraphs following). It will stand an electric arc better than hard fibre, or any moulded insulation of resinous material. The coefficient of expansion is .00002 per degree Centigrade.

Micarta is insoluble in practically all the ordinary solvents such as alcohol, benzene, turpentine, weak solutions of acid or alkali, hot water, and oils. It is not affected by ozone, a feature that makes it superior to hard rubber, and resins, for electrical purposes. It is water-resisting and non-hygroscopic.

### No. 213 Micarta Plate—Brown

**Applications**—This material is recommended for all applications where high mechanical strength is required, or for general application on account of its electrical and mechanical qualities.

**Characteristics**—No. 213 Micarta is the standard Micarta plate, brown in color, which has the following characteristics:

Will stand for short periods temperatures as high as 140 degrees Centigrade.

Sizes,  $\frac{1}{4}$  to 2 inches thick, standard sheets 36x36 inches, can be cut to any required dimensions.

Can be sawed to size, also drilled and tapped across the grain.

In thicknesses to  $\frac{1}{8}$  inch, when heated, can be punched with simple dies.

Takes a good polish.

### No. 423 Micarta Plate—Black

(Formerly No. 323)

No. 423 is an insulating plate of the same characteristics as No. 213 but black in color. It is a good substitute for hard rubber and similar materials for miscellaneous insulating purposes.

### No. 21-X Micarta Plate—Tan

An extremely dense and non-hygroscopic material to be used where minimum absorption is required.

**Characteristics**—No. 21-X is a Micarta plate of somewhat higher grade than the standard No. 213. Its characteristics are:

Will stand for short periods temperatures as high as 140 degrees Centigrade.

## MICARTA—Continued

Sizes,  $\frac{1}{8}$  to 2 inches thick, standard sheets 36x36 inches, can be cut to any required dimensions at a slight additional charge.

Can be sawed to size, drilled and tapped across the grain, takes an excellent polish.

Thin sheets are more brittle than No. 213.

**No. 429 Micarta Plate—Black**

(Formerly No. 32-X)

No. 429 is an insulating plate of the same characteristics as No. 21-X but black in color. It takes an excellent polish either with or across the grain.

This grade should be used when a satin finish is to be applied or when the edges are to be beveled.

**No. 217 Micarta—Tan**

**Application**—This material is recommended especially for making punchings or where drilling, tapping, or considerable machining is required.

**Characteristics**—No. 217 is a Micarta plate, tougher and more nearly homogeneous than the No. 213 or 21-X grades. It is moisture-resistant but not to the same extent as the No. 21-X grade. It will stand a temperature of 125 degrees Centigrade for short periods.

Sizes,  $\frac{1}{8}$  inch to 2 inches thick, standard sheets 36x36 inches, can be cut to any required dimensions. It can be drilled and tapped with and across the grain and takes a high polish.

In drilling, the drill should be ground slightly off center and run at high speed with slow feed.

**No. 427 Micarta—Black**

(Formerly No. 327)

No. 427 is an insulating plate of the same character as No. 217 but black in color. It takes an excellent polish and has the same applications and characteristics as No. 217 plate.

**No. 21-D Micarta Plate**

**Application**—The chief feature of No. 21-D plate is its toughness. It is recommended for general insulating purposes where an insulator of high mechanical strength is required.

**Characteristics**—No. 21-D is much less brittle than the other Micarta plates. It punches better and does not shatter.

Will stand temperatures as high as 140 degrees Centigrade.

Sizes,  $\frac{1}{8}$  to 2 inches thick, up to approximately 35 inches by 36 inches.

**No. 21-H Micarta**

No. 21-H Micarta is a material developed especially for use in the manufacture of gears and pinions. Gearing made from No. 21-H Micarta is noiseless in operation and this quality in combination with its strength, resiliency and wearing properties make it of particular value for this application.

No. 21-H Micarta does not absorb oil or water and gears made from it may be run in hot oil with satisfactory results.

No. 21-H Micarta may also be used for many mechanical and electrical purposes requiring great strength and good machining qualities or where drilling and tapping with the grain are necessary.

**No. 21-M Micarta**

This material was developed primarily for use in the manufacture of noiseless gears and pinions where it is desirable to cut these gears and pinions from plate stock. This grade of Micarta can be sawed more readily than No. 21-H and gears made from it may be run in hot oil. It resembles No. 21-D in general properties, but is stronger, more resilient and wears better than No. 21-D. It has good machining properties.

**No. 238 Micarta**

No. 238 Micarta was first developed as a material for gears and pinions of small pitch and thickness. Like 21-M Micarta, it is very strong and tough. Because of its finer grain and densely homogeneous structure, No. 238 Micarta can be machined more nearly to exact size; thus, it makes possible the cutting of gear teeth of very small pitch and thickness. This quality makes it especially suited to the manufacture of small objects and small gears, such as are used on graphophones.

**Micarta Rods**

Micarta rods are turned from both tan and black Micarta plate and so have the same general characteristics as the plate. They are very useful as spacers, mandrels, and cores as they are not affected by moisture or atmospheric changes. Being made from plate stock, Micarta rod can not be used in such applications as rollers and casters, where pressure is applied in the direction of the grain.

**Micarta Tubing****No. 213 Micarta Tubing**

This is the standard Micarta tubing. It has the general characteristics as No. 213 Micarta plate.

It will stand for short periods a temperature as high as 140 degrees Centigrade.

This tubing can be machined but not threaded.

**No. 213 Navy Micarta Tubing**

This tubing has the same general characteristics as our standard grade except that it can be threaded very easily. This grade should be specified only when a tube capable of being threaded is desired. It is tan in color.

**No. 323 Micarta Tubing**

This tubing is the same as the No. 213 grade except that it is black in color.



## MICARTA—Continued

**No. 403 Micarta Tubing**

No. 403 Micarta tubing is a form which has the same electrical properties as No. 213 Micarta tubing but differs in its chemical and thermal properties. No. 403 Micarta tubing is not affected by oil but is acted on by chemicals and heat in very much the same way as ordinary resin, and is affected by alcohol, benzine, turpentine, water and other solvents. However, there are many applications where No. 403 Micarta tubing is just as satisfactory as No. 213 Micarta tubing.

This tubing will stand for short periods of time temperatures as high as 100 degrees Centigrade. If subject to greater heat while under stress, distortion may occur.

**Application**—This grade of tubing can be used for applications where good insulation is desired and where it will not be subject to high temperatures under stress or to severe moisture conditions.

**No. 53 Micarta Tubing**

This tubing is similar to the No. 403 grade in electrical properties.

It will stand a temperature of approximately 60 degrees Centigrade. At higher temperature it tends to soften and collapse.

It is affected more by solvents than No. 403.

It is not affected by oil and may therefore be used to advantage in transformer applications.

**No. 121 Moulded Micarta Pump Washers**

We have developed a material known as No. 121 Micarta for use with pump valves. It is made from cotton fibre and a binder, both of which are heat resisting. In this combined form the material is non-hygroscopic and is not affected by oil, weak solutions of acids or alkalis or by similar solvents. All of these properties make it especially suitable for pump valves.

No. 121 Micarta is much stronger than materials used heretofore and does not shrink, swell, or warp. Because it is very strong and tough and of a fibrous nature it stands up in service much longer than rubber and other compositions generally used for this application.

This material is not affected by high pressures and may be used under temperature up to approximately 110 degrees Centigrade.

No. 121 Micarta pump valves are especially valuable for use in mine pumps where they are subject to the corrosive action of the chemicals

in mine water. They are also recommended for oil and gasoline pumps as well as regular water pumps where hard valves can be used.

**Micarta Friction Materials**

Micarta friction materials have been developed as more efficient friction products. They are made with cork or cork and fabric as a base.

For friction purposes, these materials are superior to any known substance.

The coefficient of friction is very high, at least double that of leather on iron. The value of this coefficient under normal working conditions is from .35 to .40. Running against well prepared steel plates without lubrication the coefficient may be .5 or higher. This high coefficient of friction has a decided bearing on the design of friction-driven machines. They are made smaller and consequently cheaper or the operating pressure may be reduced which greatly simplifies the problem of thrust bearings. Lubrication of Micarta friction materials has very little effect on the friction properties. Naturally, the coefficient is decreased somewhat as long as an oil film is maintained, but in nothing like the same proportion as with other materials. Some of the hard woods, for example, have a good coefficient when running dry, but with a small amount of lubrication the friction drops off more than half. This is not true with Micarta friction materials. They do not become oil-soaked and are but slightly affected by moisture.

Micarta friction materials are adaptable to friction drives and to clutch linings. Each class of application is studied by our engineers to determine the density and the combinations to give the best results.

For friction drive applications, the materials are durable and do not become glazed. Having a higher coefficient of friction they may be operated at a smaller slip than materials customarily used, thus giving a correspondingly greater life.

Since the special binder we use does not soften, it will stand a considerable amount of heat without damage. With other forms of prepared cork, friction heat causes the bond to flow and allows the material to disintegrate. The bond in Micarta friction materials cannot be melted or softened by heat. Neither can it be dissolved by oil, water or chemicals.

Micarta friction materials are supplied in a variety of forms to meet the requirements of the trade. For spur frictions it is supplied in the form of moulded rings for mounting on metal hubs or spiders.

MICARTA—Continued

Micarta Special Formed Shapes

We are prepared to manufacture Micarta in special formed shapes such as channels, angles collars, and spool ends, to meet the requirements of various applications. This material will have substantially the same characteristics as our standard Micarta plate. Prices will be quoted on application.

Instructions for Ordering

In ordering Micarta plate, care should be taken to specify the grade required. Standard sheets should be ordered whenever possible. In ordering tubing, inside diameter, outside diameter and length should be specified. If no specific length is given, tubing will be shipped in varying lengths above one foot.

PHYSICAL CHARACTERISTICS OF MICARTA PLATE

	GRADES						
	213 423 (formerly 323)	21-X 429 (formerly 32-X)	21-D 427 (formerly 32-X)	217 427 (formerly 327)	21 H	21-M	238
POUNDS, PER SQUARE INCH							
<b>Bending Test Flatwise</b>							
Max. Fibre Stress.....	25,000	18,000	17,000	22,000	25,000	20,000	20,000
<b>Bending Test Edgewise</b>							
Max. Fibre Stress.....	20,000	16,000	18,000	20,000	25,000	20,000	20,000
<b>Compression Test Flatwise</b>							
Ult. Compressive Strength ..	42,000	34,000	37,000	35,000	10,000	40,000	40,000
Elastic Limit.....	28,000	18,000	15,000	15,000	35,000	30,000	30,000
<b>Compression Test Edgewise</b>							
Ult. Compressive Strength...	22,000	20,000	21,000	20,000	20,000	22,000	22,000
Elastic Limit.....	14,000	12,000	12,500	14,000	15,000	18,000	18,000
<b>Tensile Test</b>							
Ult. Tensile Strength .....	15,000	9,000	10,000	10,000	18,000	10,000	10,000
Elastic Limit .....	12,000	7,000	6,000	7,000	12,000	7,000	7,000
Modulus of Elasticity .....	1,400,000	1,400,000	1,100,000	1,200,000	1,700,000	1,100,000	1,100,000
<b>General</b>							
Specific Gravity.....	1.36	1.36	1.36	1.36	1.36	1.39	1.38
Weight, lbs. per cubic inch...	.05	.05	.05	.05	.05	.05	.05
Coefficient of expansion.....	.00002	.00002	.00002	.00002	.00002	.00002	.00002

PHYSICAL CHARACTERISTICS OF MICARTA TUBING

	GRADES		
	213-423	403	53
Tensile Strength (lbs. per sq. inch).....	4,000	3,000	3,000
Compressive Strength (lbs. per sq. inch).....	13,000	10,000	10,000
Specific Gravity.....	1.12	1.12	1.05

ELECTRICAL PROPERTIES OF MICARTA

Breakdown Voltage

	*Breakdown Voltage per Mil. of Thickness
213, 423, 403 or 53 Plate or Tubing.....	900
21X or 429 Plate.....	800
21D Plate.....	150
217 or 427 Plate.....	600
21H.....	400

\*These values are based on one minute tests on plate 1/4 inch thick.

MICARTA—Continued

PRICES

Micarta Plate

Thickness Inches	LIST PRICE, PER POUND						
	213 423 (formerly 323)	217 427 (formerly 327)	21-X 429 (formerly 32X)	21-H	21-D	21-M	238
$\frac{1}{8}$	\$2 50	\$2 50	.....	.....	\$2 25	.....	.....
$\frac{1}{4}$	2 25	2 25	.....	.....	2 10	.....	\$2 25
$\frac{3}{8}$	2 10	2 10	\$2 25	\$2 25	.....	.....	2 10
$\frac{1}{2}$	2 05	2 05	2 10	2 10	.....	.....	2 05
$\frac{5}{8}$	2 05	2 05	2 05	2 05	.....	.....	2 05
$\frac{3}{4}$ to 2	2 00	2 00	2 00	2 00	\$2 00	\$2 00	2 00
2 to 3	.....	.....	.....	.....	.....	.....	2 00

Estimate weights of all grades at 20 cubic inches per pound or on the basis of one pound, one ounce per  $\frac{1}{4}$  inch of thickness. Sheets of any thickness between the maximum and minimum thicknesses specified above can be supplied. If plates are required cut to size, additional charge will be made. Micarta plates are manufactured to close variations in thickness. Where especially close limits are required, slight additional charge will be made. Standard size plate is 36x36 inches, except 21D, which is 35x36 inches.

Micarta Rod

Diam. Inches	APPROX. WEIGHT PER 10 FT.		List Price Per Foot	Diam. Inches	APPROX. WEIGHT PER 10 FT.		List Price Per Foot
	Lbs.	Oz.			Lbs.	Oz.	
$\frac{1}{8}$	0	4 $\frac{1}{2}$	\$0 34	1	4	10	\$2 16
$\frac{1}{4}$	0	7 $\frac{1}{4}$	44	$1\frac{1}{8}$	5	14	2 62
$\frac{3}{8}$	0	10 $\frac{1}{2}$	52	$1\frac{1}{4}$	7	4	3 08
$\frac{1}{2}$	0	12	64	$1\frac{3}{8}$	8	13	3 69
$\frac{5}{8}$	1	2 $\frac{1}{2}$	77	$1\frac{1}{2}$	10	7	4 33
$\frac{3}{4}$	1	6	91	$1\frac{5}{8}$	12	4	4 96
$\frac{7}{8}$	1	13	1 08	$1\frac{3}{4}$	14	5	6 19
1	2	1	1 22	$1\frac{7}{8}$	16	6	7 32
$1\frac{1}{8}$	2	10	1 41	2	18	10	8 63
$1\frac{1}{4}$	3	9	1 77				

Standard length of rod approximately 36 inches. Information on rods of diameters greater than 2 inches will be furnished on request. Rods are made with variations of not more than  $\frac{1}{4}$  inch greater than the specified diameter; they are never made with a smaller diameter than that specified.

No. 121 Micarta Pump Washers

Style No.	Outside Diameter, Inches	Inside Diameter, Inches	Thickness, Inches	List Price Each
290816	2	$1\frac{1}{2}$	$\frac{1}{4}$	\$0 21
290817	2 $\frac{1}{4}$	$1\frac{3}{4}$	$\frac{1}{4}$	17
290818	2 $\frac{1}{2}$	$1\frac{7}{8}$	$\frac{1}{4}$	35
290819	3	$2\frac{1}{8}$	$\frac{1}{4}$	45
290820	3 $\frac{1}{2}$	$2\frac{3}{8}$	$\frac{1}{4}$	62
290821	4	$2\frac{7}{8}$	$\frac{1}{4}$	1 00
290822	4 $\frac{1}{4}$	$3\frac{1}{8}$	$\frac{1}{4}$	1 28
290823	5	$3\frac{7}{8}$	$\frac{1}{4}$	1 58
290824	6	$4\frac{3}{8}$	$\frac{1}{4}$	2 27

No. 21-D Micarta Pump Washers

Washers cut from No. 21-D Micarta plate can also be furnished and will have the same general characteristics as the No. 21-D plate.

List prices should be obtained from gear blank schedule listed on page 691.

Order by Style Number





## MICA INSULATION

The part of an electrical machine most liable to failure is the insulation. In an effort to reduce this weakness of electrical machinery, Westinghouse engineers have devoted much research to obtain better insulation—insulation that would be as good as the Westinghouse motors and generators upon which it was to be used. In particular, their work has effected many improvements in the manufacture of mica insulation, but neither Westinghouse engineers nor any others have ever found a satisfactory substitute for mica. Its high dielectric strength, its resistance to heat, its great flexibility, all combine to make it the most widely used insulating material.

The Westinghouse Company uses two of the common grades of mica: amber Canadian mica (phlogopite), from its own mines, and white Indian mica (muscovite). These micas are selected and graded to agree with established standards, the results of tests and observations made by Westinghouse engineers upon the manufacture, application, and performance of mica insulation. Splittings of the native mica are then built up into three finished forms: sheet mica, hot moulding mica, and cold moulding mica. Sheet mica is used for all flat work, such as the insulating segments on commutators and heating apparatus. Hot moulding mica is used for moulding bushings, washers, commutator V-rings, channels, and corner cells. Cold moulding mica is used, without being heated, for bending around sharp corners, such as are encountered in forming slot insulation, coil wrappers, and coil sheaths. Cold moulding mica, combined with fullerboard, cambric, fish paper, or Japanese paper, may also be obtained in wrapper form.

### Sheet Mica

#### No. 210 Amber Mica Plate

No. 210 Amber Mica Plate is made from selected splittings of amber mica from the Westinghouse Company's Canadian mine. It is milled to exact thickness, and is gauged and inspected to assure uniform contact and spacing between the bars of the commutator. It is especially treated to prevent any slippage of the splittings after being placed in the apparatus. There is no excess of bond to melt and flow out from the segments while a commutator is being baked. This plate is uniformly free from crushed spots and impurities.

**Uses**—Because it is the softest mica known, Canadian mica is well suited for commutators that are not undercut. Extremely soft, it prevents sparking by wearing down evenly with the copper bars of the commutator. It is suitable for other work where it will be used only in the flat form.

#### No. 207 White Mica Plate

This mica plate is similar to No. 210 amber mica except that it is made from white Indian mica.

**Uses**—This mica is used for insulating segments on undercut commutators. As it is a hard mica, it will not wear down with the copper bars, and thus will cause the commutator to spark.

### Hot Moulding Mica

#### No. 250 Heater Mica Plate

This smooth-surfaced plate is made from selected splittings so sealed and lapped that there can be no flaring or shifting of the splittings while applying the mica to the apparatus. Clean cut holes, with saw-tooth edges, can be punched for retaining the heating element. With this plate a special bond is used, which volatilizes above 200° Centigrade but does not affect the heating element nor reduce the insulating property of the mica. It is necessary to support this plate after the bond has been removed by heating. The dielectric strength of this plate is approximately 1200 volts per mil.

**Uses**—This mica is suitable, either in flat or moulded form, for insulating heating appliances, the operating temperatures of which do not exceed 800° Centigrade.

#### No. 209 Heater Mica Plate

This plate is similar to No. 250 mica plate, but is made from a different grade of mica.

**Uses**—This mica, in either flat or moulded form, is used for insulating heating appliances in which the operating temperatures do not rise beyond 400° Centigrade.

#### No. 251 White Moulding Mica

This is a white mica plate so bonded as to become flexible when heated. It is free from crushed spots and impurities and is very compact.

**Uses**—This mica is used for moulding bushings, washers, commutator V-rings, channels, and corner cells. It cannot be used for commutator segment insulation.

### Cold Moulding Mica

#### No. 237 Flexible Mica Plate

Large, thin splittings of white Indian mica, together with an elastic bond, give this mica plate a lasting flexibility. The overlapping edges of the splittings are especially sealed so that shifting or flaring, while bending the plate to acute angles, is impossible. The average dielectric strength of this plate is 600 volts per mil.

**Uses**—This mica is used, without heating, for bending around sharp corners, such as are encountered in forming slot insulation, coil wrappers, and coil sheaths. Unless protected by tape or similar means, it is not recommended for applications in which it might be subject to frictional wear.

MICA INSULATION—Continued

**No. 228 Mica Tape**

This tape is made from uniformly thin splittings of mica, reinforced on both sides with Japanese paper, and cemented with a special bond. The tape is built up with great care, to assure uniform thickness and flexibility. Because of the special bond used, the tape, for a short time after it has been applied, can be tightened and will stay in place. In order to retain the original flexibility of the tape, the bond is not completely dried out. However, it is not left so wet as to loosen the fibers of the Japanese paper and destroy the paper's tensile strength. The average dielectric strengths for the .004-inch and .006-inch thicknesses are 2500 volts per mil and 4500 volts per mil, respectively.

**Uses**—This tape is used where sheet material cannot be conveniently applied: that is, for insulating closed coils and for sharp bends on large and small coils.

**No. 224 Japanese Paper and Mica**

Large, thin splittings of white mica, so cemented with an elastic bond as to prevent any shifting, together with Japanese paper, make up this wrapper. Its approximate dielectric strength is 400 volts per mil.

**Uses**—This wrapper is especially suitable for small coil wrappers, curved washers, and spacing strips.

**No. 229 Treated Cement Paper and Mica**

This wrapper is made from thin, white mica, reinforced with .008-inch treated cement paper, and covered with Japanese paper. It may be very tightly wrapped, so as to eliminate air pockets and secure the greatest conduction of heat. This keeps the temperature of the insulation low and so prolongs its life. Its approximate dielectric strength is 1300 volts per layer.

**Uses**—It is especially useful for coil wrappers where high dielectric strength is required, but where the space for insulation is small.

**No. 232 Fish Paper and Mica**

This wrapper is similar to No. 229, but is reinforced with fish paper instead of cement paper, and so has greater dielectric strength. The fish paper, which is extremely flexible and tough, enables the wrapper to stand much mechanical abuse. Its average dielectric strength is approximately 6000 volts per sheet.

**Uses**—This wrapper is especially suitable for coil insulation and coil wrappers which may be subjected to mechanical abuse.

**No. 240 Cambric and Mica**

This is a flexible, white mica sheet, reinforced with .007-inch treated cambric and covered with Japanese paper. This wrapper has the greatest mechanical strength for its thickness. Its dielectric strength is approximately 5000 volts per sheet.

**Uses**—This wrapper is best used where flexibility with maximum mechanical strength is required: that is, for taping large field coils.

**No. 241 Fullerboard and Mica**

This wrapper consists of white mica reinforced with .007-inch fullerboard. Its mechanical strength is high and its dielectric strength is approximately 4000 volts per sheet.

**Uses**—This mica product is used for transformer and field coil insulation. It cannot be used for wrapping small armature coils.

**No. 308 Fullerboard and Mica**

This is similar to No. 241 fullerboard and mica except that the mica sheet is thicker. Its dielectric strength is approximately 10,000 volts per sheet.

**Uses**—This should be used for transformer and field coil insulation. It is unsuitable for wrapping small armature coils.

**Mica Tubes**

Mica tubes are made from thin splittings of white mica, cemented with a tough, adhesive bond and reinforced with Japanese paper. They are very compact and uniform in thickness of the wall.

**Uses**—These tubes are for use as insulating sleeving on grid resistor tie-rods and similar applications.

**PRICES**

Sizes shown below are standard and carried in stock. Any of the products listed will be furnished in practically any size or shape or built to any

thickness required without appreciable delay. A slight additional charge will be made for special sizes, shapes and thickness.

**Sheet Mica**

Material	Standard sheet, inches	Standard thickness, inches	Approx. wt., lbs. per sheet	Application	List Price per pound
*No. 210 Amber Mica Plate	24x36	.018	1.50	Commutator strips, over 1/2-inch long, on all industrial motors and other motors where not under cut.	\$5 90
*No. 210 Amber Mica Plate	24x36	.020	1.60		5 90
*No. 210 Amber Mica Plate	24x36	.025	2.00		4 50
*No. 210 Amber Mica Plate	24x36	.030	2.40		4 50
*No. 210 Amber Mica Plate	24x36	.032	2.60		4 50
*No. 210 Amber Mica Plate	24x36	.035	2.80		4 50
*No. 210 Amber Mica Plate	24x36	.040	3.20		4 50
*No. 210 Amber Mica Plate	24x36	.045	3.60		4 50
*No. 210 Amber Mica Plate	24x36	1/4	3.80		4 50
*No. 210 Amber Mica Plate	24x36	.050	4.00		4 50
*No. 210 Amber Mica Plate	24x36	.060	4.80		4 50
*No. 210 Amber Mica Plate	24x36	1/2	4.10		4 50

\*For commutator work, only plate milled to exact thickness is furnished.

(Continued on next page)

MICA INSULATION—Continued

Sheet Mica—Continued

Material	Standard Sheet, inches	Standard thickness, inches	Approx. wt., lbs. per sheet	Application	List Price per Pound
*No. 207 White Mica Plate	24x36	.018	1.50	Commutator strips, over 1/4-inch long, under cut, on all except industrial motors.	\$3 10
*No. 207 White Mica Plate	24x36	.020	1.40		2 80
*No. 207 White Mica Plate	24x36	.025	1.75		2 80
*No. 207 White Mica Plate	24x36	.030	2.10		2 80
*No. 207 White Mica Plate	24x36	☆	2.18		2 80
*No. 207 White Mica Plate	24x36	.035	2.45		2 80
*No. 207 White Mica Plate	24x36	.040	2.80		2 80
*No. 207 White Mica Plate	24x36	.045	3.15		2 80
*No. 207 White Mica Plate	24x36	†	3.22		2 80
*No. 207 White Mica Plate	24x36	.050	3.50		2 80
*No. 207 White Mica Plate	24x36	.060	4.20		2 80
*No. 207 White Mica Plate	24x36	‡	4.36		2 80
*No. 207 White Mica Plate	24x36	§	6.54		2 80
*No. 207 White Mica Plate	24x36	¶	8.72		2 80

Hot Molding Mica

No. 209 Heater Mica Plate	22x27 1/4	.010	.70	Heating Apparatus	4 35
No. 209 Heater Mica Plate	22x27 1/4	.012	.84		5 00
No. 209 Heater Mica Plate	22x27 1/4	.015	1.05		5 00
No. 250 Heater Mica Plate	24x36	.010	.75		3 00
No. 250 Heater Mica Plate	24x36	.015	1.12		3 00
No. 251 White Mica	24x26	.015	1.00	Simple forming such as washers, collector bushings, cells, and commutator V-rings	2 70
No. 251 White Mica	24x36	.020	1.33		2 60
No. 251 White Mica	24x36	.025	1.66		2 15
No. 251 White Mica	24x36	.030	1.98		2 15
No. 251 White Mica	24x36	☆	2.05		2 10
No. 251 White Mica	24x36	.035	2.31		2 10
No. 251 White Mica	24x36	.040	2.66		2 10
No. 251 White Mica	24x36	.045	2.99		2 10
No. 251 White Mica	24x36	†	3.06		2 10
No. 251 White Mica	24x36	.050	3.32		2 10
No. 251 White Mica	24x36	‡	4.62		1 70
No. 251 White Mica	24x36	§	6.15		1 30
No. 251 White Mica	24x36	¶	9.24		1 30

Cold Molding Mica

No. 237 Flexible Mica	24x36	.005	.42	General use	4 80
No. 237 Flexible Mica	24x36	.010	.85		2 90
No. 237 Flexible Mica	24x36	.015	1.26		2 80
No. 237 Flexible Mica	24x36	.020	1.70		2 15
No. 237 Flexible Mica	24x36	☆	2.72		2 15
No. 228 Mica Tape rolls	1/4-inch wide	.004	.6	(50 yards) } General taping	3 70
No. 228 Mica Tape rolls	3/4-inch wide	.006	.6		(40 yards) } 4 45
No. 224 Japanese Paper and Mica	24x36	.004	.16	General use	4 10
No. 224 Japanese Paper and Mica	24x36	.006	.37		3 85
No. 224 Japanese Paper and Mica	24x36	.008	.76		3 45
No. 229 Cement Paper and Mica	40x36	.015†	1.17	—Coil wrapping	1 60
No. 232 Fish Paper and Mica	40x36	.012‡	1.16	—Cell insulation	2 80
No. 240 Treated Cambric and Mica	25x32	.013**	1.05	—Cell insulation	2 65
No. 241 Fullerboard and Mica	36x40	.013	1.13	(30 yards)—Cell insulation	3 00
No. 308 Fullerboard and Mica	36x40	.015§	.010¶	1.01—Transformer and field coils	1 50
			.015§	1.40—Transformer and field coils	2 10

\*For commutator work, only plate milled to exact thickness is furnished.

†Thickness of paper .008.

‡Thickness of paper .004.

\*\*Thickness of cambric .006.

§Thickness of fullerboard .007.

Mica Tubes

Inside diameter, inches	Maximum length, inches	List price per foot, 1/8-inch wall	List price per foot, 1/4-inch wall	Inside diameter, inches	Maximum length, inches	List price per foot, 1/8-inch wall	List price per foot, 1/4-inch wall
1/4	12	\$0 11	\$0 19	5/8	12	\$0 19	\$0 32
1/2	12	11	19	1	32	19	32
3/4	12	13	24	1 1/4	32	21	35
1	24	11	24	1 1/2	12	24	38
1 1/4	32	11	24	1 3/4	24	27	41
1 1/2	24	11	24	2	32	30	44
1 3/4	24	17	32	2 1/4	32	33	47
2	12	17	32	2 1/2	32	36	50
2 1/4	32	17	32	2 3/4	32	39	53
2 1/2	32	17	32	3	32	42	56

The prices above are for standard wall thicknesses. Prices of tubes of thicknesses other than those above will be quoted on request.



## TREATED CLOTH AND PAPERS

Treated cloth and papers comprise a class of insulating materials concerning which accurate data cannot readily be obtained. The data usually given—puncture voltage for a given thickness—is of little value, because the conditions under which the material is used are totally different from those under which the data was obtained. Tests on treated materials, to be a reliable guide, should be made under conditions as near as possible like those under which the material is to be used. The user, by carefully testing and selecting his insulating materials, will be amply repaid by the resulting freedom from the expense of reinsulating defective work, assurance of satisfactory service, and economy of material.

The products listed below are materials which are made primarily for use in the manufacture of Westinghouse electrical apparatus. The raw materials are tested in conformity to rigid specifications, and the finished materials are inspected carefully to assure uniformity at all times.

### Treated Cloths

A varnished cloth derives its insulating value largely from the varnish with which it is treated, the fabric serving merely as a support. The effectiveness of the treated material as an insulator depends upon the fabric supporting the varnish film in such a way as to prevent injury to the film from distortion while applying it to the parts to be insulated. A tough, flexible varnish properly combined with a strong, closely woven, pliable fabric will produce the combination most capable of successfully meeting the severe requirements of this class of material.

**Tan Treated Cloth** is a strong, pliable insulation, highly oilproof and moistureproof, and very durable. In bias form it can be applied smoothly and easily, without injury to the varnish film. It is used for coil wrappers, cells and armatures and insulating washers. This material deteriorates if left exposed, and, therefore, should not be kept in storage for any great length of time.

**Black Treated Cloth** carries a varnish which is especially designed to withstand high temperature and high electrical stress. The varnish film is slightly softer than that of tan cloth and so will not resist abrasion quite as well. It has an oily surface which renders it more moisture repellent and also acts as a lubricant. This lubrication permits of drawing the surfaces into closer contact, thus forming a more

solid insulation when built up of numerous layers. It is especially useful in tape form.

**Treated Cloth Tape**, both tan and black varieties, are cut from the corresponding treated cloths. The tan tapes have a tacky finish.

**Varnished Duck No. 30** is 12½-ounce duck treated with a black flexible varnish which makes it waterproof. The material has good insulating properties without being liable to cracking. It is used as a hood on railway motor armatures and for insulating where a strong tough material is demanded by the mechanical conditions, such as for washers under field coils.

**Varnished Drilling No. 20** is the same as No. 30 except made from a duck of lighter weight.

**Tan Treated Cloth Nos. 7-10-12-15** differ only in thickness and have just the proper amount of surface grip to make them most convenient in application.

**Black Treated Cloth No. 1000** is a straight cloth.

**Black Treated Cloth No. 1007** is a straight cloth.

**Black Treated Cloth No. 1010** is the same material as the No. 1000 but is cut bias. The joints are butted and sewed before treating.

**Black Treated Cloth No. 1017** is the same material as the No. 1007 but is cut bias. The joints are butted and sewed before treating.

**Tan Treated Cloth Tape, bias cut**, is cut from our tan treated cloths and has the same characteristics as these cloths.

**Black Treated Cloth Tape** is made bias cut from No. 1010, and No. 1017 cloths.

**Combination Slot Insulation** consists of treated cambric cemented to fish paper by a special insulating varnish, so selected and applied that the finished material:

Has high dielectric strength.

Will not deteriorate as rapidly as the standard treated cambric when exposed to air at high temperatures.

Has sufficient flexibility to be formed and is rigid enough to be forced into place in the slots and to retain the shape to which it was formed.

Is so tough that it will not tear or break at the corners when the coil is driven compactly down into the slot.

This material, by compactly combining cloth and paper, divides the strain proportionately between the two. Therefore less fish paper is used, as the treated cloth takes up the strain which formerly was placed on the paper.

### PRICES

In ordering specify the material wanted by number and name, also the size and number of rolls or sheets wanted. Standard rolls and sheets are carried in stock for immediate shipment. Rolls of any length, and sheets cut to any size, will be furnished when specified.

#### Tan Treated Cloths

Standard rolls 25 and 50 yards.

No.	Thick- ness	Width Inches	Average Breakdown Voltage	Approx. Wt. Per Sq. Yd.	List Price Per Sq. Yd.
7	.007	36	7,000	.47	\$0 57
10	.010	36	10,000	.60	64
12	.012	36	12,000	.74	74
15	.015	36	15,000	.92	81

#### Black Treated Cloths

Standard rolls 25 and 50 yards

No.	Thick- ness	Width Inches	Average Breakdown Voltage	Approx. Wt. Per Sq. Yd.	List Price Per Sq. Yd.
1007	.007	36	7,000	.47	\$0 59
1017	.007	34 to 36	7,000	.47	70
1000	.010	36	10,000	.60	72
1010	.010	34 to 36	10,000	.60	77

5-110A

TREATED CLOTHS AND PAPERS—Continued

PRICES—Continued

Varnished Duck					Combination Slot Insulation			
No.	Thick-ness	Width Inches	Average Breakdown Voltage	Approx. Wt. Per Sq. Yd.	List Price Per Sq. Yd.	Standard Sheet, Inches	Thickness, Inches	List Price Per Sq. Yd.
30	.030	36	.....	1.19	\$1 20			
<b>Varnished Drilling</b>						36x36	.014 to .015	\$0 86
20	.020	36	.....	1 00	1 00	36x36	.015 to .018	1 06
						36x36	.022 to .024	1 20

Treated Cloth Tapes

Standard packages 20, 40 and 80 rolls.

Width	.007 THICK		.010 THICK		Tan Cloth Tapes		Black Cloth Tapes	
	Approx. Weight Oz. Per Roll	Approx. Weight Oz. Per Roll	Approx. Weight Oz. Per Roll	Approx. Weight Oz. Per Roll	LIST PRICE PER 36 YD. ROLL	LIST PRICE PER 36 YD. ROLL	LIST PRICE PER 36 YD. ROLL	LIST PRICE PER 36 YD. ROLL
1/2	3.5	4.3	4.3	5.2	\$0 35	\$0 43	\$0 38	\$0 45
3/8	4.4	5.4	5.4	6.5	45	52	45	52
1/2	5.25	6.5	6.5	7.1	54	61	61	65
3/4	6.5	7.1	7.1	8.6	61	71	71	75
1	7	8.6	8.6	10.75	71	81	75	85
1 1/4	8.75	10.75	10.75	13	85	98	95	1 10
1 1/2	10.5	13	13	15	1 05	1 20	1 20	1 30
1 3/4	12.25	15	15	17.2	1 25	1 45	1 35	1 45
2	14	17.2	17.2		1 40	1 60	1 60	1 70

Treated Papers

In many instances the application does not require an insulator of extreme flexibility; or a material of greater stiffness than treated cloth is required. In such cases, treated papers are generally used. The line of Westinghouse treated papers includes such materials as have been found especially adapted for insulation purposes. These papers are treated in much the same way as Westinghouse treated cloths and are produced under the same careful supervision and subject to the same rigorous test and inspection. They are taken from the stock used in the manufacture of Westinghouse apparatus.

**Treated Cement Paper** is made by a special process from rope cement paper and is remarkably strong and tough. The treatment is similar to the process for treated cloth and gives the paper a firm smooth surface and actually increases its flexibility. It is used for armature coil insulation, washers, and spacing pieces.

**Paraffined Fishpaper** consists of fishpaper thor-

oughly impregnated with paraffine to exclude moisture and to make it more convenient to handle. Fishpaper is the strongest and toughest of the insulating papers and is especially adapted for service where ability to resist mechanical injury must be combined with good insulating qualities. Used for slot cells, coil wrappers, and washers.

**Treated Fullerboard** is prepared by removing the moisture in a vacuum oven and then coating with an oil-proof, moisture-repellent, baking varnish. The product has good dielectric properties and is useful where good insulating qualities must be combined with mechanical rigidity. When exposed to the air all cut edges require a protecting coat of varnish or shellac. When immersed in good insulating oil and thoroughly saturated its dielectric strength is approximately trebled. This property makes it especially valuable for service where it will be continually immersed in insulating oil. It is used for angles and channels as well as in sheet form.

PRICES

Treated Cement Paper

No.	Thick-ness	Width of Std. Roll Inches	Average Breakdown Voltage	Approx. Wt. Lbs. Per 100 Sq. Yds.	List Price Per Sq. Yd.
8	.008	40	7500	45 1/2	\$0 27
13	.013	40	8000	70	36
18	.018	40	8500	85	43

Paraffined Fish Paper

No.	Thick-ness	Width of Std. Roll Inches	Average Breakdown Voltage	Approx. Wt. Lbs. Per 100 Sq. Yds.	List Price Per Sq. Yd.
1	.005	40	2000	22	\$0 17
2	.008	40	3600	36 1/2	26
3	.011	40	5500	52	36
4	.016	40	6200	89	51

Paraffined Express Paper

No.	Thick-ness	Width of Std. Roll Inches	Average Breakdown Voltage	Approx. Wt. Lbs. Per 100 Sq. Yds.	List Price Per Sq. Yd.
7	.008	50	1500	44	\$0 18

Treated Fullerboard

No.	Thick-ness	Std. Sheet Inches	Wt. Per Sheet	List Price Per Sheet
35	.035	36x 56	14300	3 lbs. \$0 77
60	.060	40x 42	18100	3 1/4 lbs. 1 40
130	.130	55x120	21200	7 3/4 lbs. 2 25

## UNTREATED CLOTHS AND PAPERS

All insulating materials here listed are of specially selected stock and of the kind used in the manufacture of Westinghouse electrical machinery and apparatus. Purchasers, therefore, receive the benefit of our long experience and can feel assured that the material purchased is the best obtainable.

The uses to which these untreated materials are put are so many that no attempt is made in these pages to enumerate them. A short description of the principal characteristics of each material follows.

### Untreated Papers

**Fishpaper** is a very tough, strong, specially prepared paper, somewhat resembling hard fibre but considerably more flexible. Color, dark gray.

It resists mechanical injury and heat better than any other insulating paper known, and therefore has no equal as a wrapping for coils, or for cells for armature slots. Although it will stand baking for a short time, it should not be used in apparatus that is to be impregnated unless special precautions are taken.

Fishpaper is not affected by lubricating or transformer oil, but will absorb moisture like all other papers unless paraffined or otherwise treated. It is used with mica, as fishpaper and mica, in making wrappers. The thinner paper may be folded and creased without destroying the fibre or the dielectric strength.

In general, fishpaper is adapted for use where a tough material affording mechanical protection as well as insulation is required. It should be creased across and not with the grain.

**Express paper** is a high grade wood fibre paper used as a protection for coils where moderate mechanical strength in a thin material is required: for instance, on bars of squirrel-cage rotors of induction motors. Treated with paraffine it is sometimes used in alternating-current motors. The stock selected is very strong, and care is taken to have it free from pin-holes. Color, mottled tan.

**Cement papers**, also called rope cement papers or rope papers, are made from good grade of hemp rope stock, and are, consequently, long fibred and strong. They are sometimes used as spacing and as a protection to the cotton insulation in winding coils. Treated with varnish they are often used as insulation between windings and around coils in transformers. The papers carried in stock are especially selected to assure freedom from pin-holes and foreign materials. Color, buff.

**Fullerboard** is a dense material like cardboard; less hard and stiff than hard fibre, and more easily worked. It is not affected by transformer or lubricating oil, but will absorb moisture like other papers unless treated. It is used between turns or as a

filler in transformer and armature coils and sometimes for washers on magnet coils. Colors, mottled black or gray.

**Hard fibre** is a very dense, hard material used for many purposes where a tough insulator is required, such as wedges for armature slots, braces for armature coils, and washers and bushings in all kinds of electrical apparatus.

### Sleeving

**Cotton sleeving** is of good grade, closely braided, intended, for instance, to slip over the leads of armature coils, for additional insulation. It is designated by nominal inside diameter. By stretching or shortening the sleeving the diameter is changed, making each diameter adaptable to several sizes of wire.

### Untreated Tapes

**.020-inch surgical tape** is closely woven on the "herring bone" pattern. It has a tensile strength of approximately 100 pounds per inch width. Used chiefly where a tape of strength and wearing qualities is required; for example, under banding wires on armatures, for taping together and bracing large field coils.

**.017-inch cotton gauze tape** is a strong gauze tape suitable for temporary taping on coils that are to be impregnated.

**.040-inch gray webbing tape** is the strongest tape listed. It is suitable for binding transformer coils, etc., and has a tensile strength of approximately 190 pounds per inch width.

**Cotton Tapes**—These linen finished tapes, sometimes called linen tapes, are used principally for coil windings. There are three grades according to thickness: .0045-inch, having a tensile strength of approximately 35 pounds per inch width; .007-inch, most generally used, with a tensile strength of about 70 pounds per inch width, and .011-inch with a tensile strength of approximately 100 pounds per inch width.

### Cord and Thread

**Elm flax thread** is a white cord about  $\frac{1}{8}$ -inch diameter twisted hard; tensile strength 30 to 40 pounds.

**Barbours flax twine** is a soft flax thread about  $\frac{1}{4}$ -inch diameter; tensile strength 6 to 10 pounds per strand.

**Four-cord machine thread** is a high grade soft flax thread about  $\frac{1}{8}$ -inch diameter; tensile strength 25 to 30 pounds.

**Torpedo twine** is a hard twisted flax twine designed to resist wear. The  $\frac{1}{2}$ -inch diameter has a tensile strength of approximately 200 pounds.

**Wax end** is a treated machine thread suitable for use where moisture must be excluded, and where an easy working thread is required.

UNTREATED CLOTHS AND PAPERS—Continued

Asbestos

**Asbestos Cloth**—Although it is more costly, a tightly woven, non-porous cloth is used by the Westinghouse Company, because the cheaper, more porous cloth does not answer the purpose either as a protection or as an insulator. It is used as a protection to the armature winding on some railway motors and other machines subject to rough usage and high temperatures.

**Asbestos sheet** contains a small amount of binder. The paper is soft and has not much mechanical strength. Used for lining metal parts such as railway circuit-breaker covers, to prevent grounds and short-circuits from arcing. Also used between turns of strap-wound coils.

**Asbestos lumber** is a hard, board-like substance consisting of asbestos and cement. It is a high grade flame-proof material which can be readily sawed, or drilled. Used for arcing boxes of switches, for barriers as protection against arcing, and in general for bases, partitions, and all places where high temperatures or arcing occur.

**Asbestos tape** is a strong, selvaged tape made of long-fibre asbestos.

**Asbestos cord** is a strong, white cord of long-fibre asbestos. Used for temporary binding together of parts subjected temporarily to high temperatures; also as packing.

**Asbestos sleeving** is a woven sleeving of asbestos. Used as fireproof insulation on coil leads, such as the leads of arc lamp coils.

PRICES

Untreated Papers—Standard Rolls: 25, 50 and 100 Yards

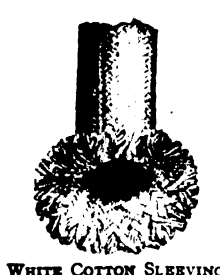
Material	Thickness Inches	Approx. Breakdown Voltage†	Width of Rolls Inches	Size of Sheets Inches	APPROX. Per 100 Sq. Yds.	WT. LBS. Per Ream	List Price Per Pound
Fishpaper	.004	1000	50	.....	22 1/2	....	\$0 78
Fishpaper	.007	1700	40	.....	40	....	68
Fishpaper	.010	2900	40	.....	58	....	68
Fishpaper	.015	4500	40	.....	90	....	68
Fishpaper	.023	7100	..	40 x 72	....	1500	68
Fishpaper	.034	10000	..	40 x 72	....	2400	68
Fishpaper	.056	20000	..	40 x 72	....	4200	68
Express Paper	.007	1500	50	24 x 36	40	130	16
Cement Paper, High Finish	.0055	900	40	.....	19	....	31
Cement Paper, High Finish	.010	1100	40	.....	34	....	31
Cement Paper, Machine Finish	.015	1500	40	.....	54	....	31
						Per Sheet	
Fullerboard (black or tan)	.007	2600	40	36 x 40	43	.32	27
Fullerboard (black or tan)	.010	3000	40	36 x 40	62	.55	27
Fullerboard (black or tan)	.015	5000	40	36 x 40	92	.82	27
Fullerboard (black or gray)	.030	12000	..	36 x 56	....	2.9	27
Fullerboard (gray)	.056	14000	..	40 x 42	....	3.6	27
Fullerboard (gray)	.075	15000	..	40 x 42	....	6.6	27
Fullerboard (gray)	.125	17000	..	55x120	775	....	27
Fullerboard (gray)	1/4	30000	..	48 x120	1550	....	27
Fullerboard (gray)	1/2	35000	..	48 x120	1938	....	27
Fullerboard (gray)	3/4	45000	..	48 x120	2325	....	27
Fullerboard (gray)	1	47000	..	48 x120	2712	....	27

†These voltages are approximate for breakdown and are not to be considered for continuous service.

White Fibre—Standard Sheets Approx. 40x60 Inches

Thickness Inches	Approx. Wt. Per Sheet in Lbs.	List Price Per Pound	Thickness Inches	Approx. Wt. Per Sheet in Lbs.	List Price Per Pound
1/8	5	\$0 50	1/8	140	\$0 64
1/16	10	50	1/16	160	71
1/32	20	50	1/32	180	85
1/64	30	51	1/64	200	1 00
1/128	40	51	1/128	220	1 20
1/256	50	51	1/256	240	1 45
1/512	60	51	1/512	260	1 75
1/1024	80	53	1/1024	280	2 25
1/2048	100	53	1/2048	300	2 25
1/4096	120	59	1/4096	320	4 25

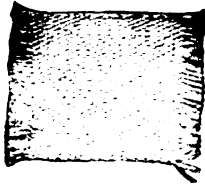
White Cotton Sleeving



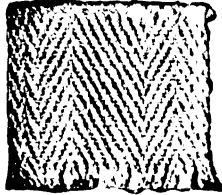
WHITE COTTON SLEEVING

Nominal Inside Diam., Inches	Will Fit Over B. & S. Gauge Wire No.	Approx. Wt., Lbs. Per Reel	Will Increase Diam. of Wire Inches	Yards Per Lb.	List Price Per Lb.
.045	17-18-19	5	.015	560	\$2 20
.0641	14-15-16	5	.015	280	2 20
.081	12-13	10	.020	204	2 20
.162	6- 7- 8	10	.020	132	2 20
.258	1- 2	10	.035	91	2 20
1/4	00	5	.035	51	2 20
1/2	0000	5	.035	47	2 20
3/4		7 1/4	.035	35	2 20
1		7 1/2	.035	28	2 20
1 1/4		8	.035	21	2 20
1 1/2		7	.035	18	2 20
		5 1/2	.035	15	2 20

UNTREATED CLOTHS AND PAPERS—Continued



COTTON TAPE



SURGICAL TAPE

Tapes

Material	Thickness Inches	Width Inches	Color	Approx. Yds. Per Roll	List Price Per Gross Yds.
Cotton Tape, linen finish	.0045	1 1/2	White	36	\$1 55
Cotton Tape, linen finish	.0045	1 1/2	White	36	1 80
Cotton Tape, linen finish	.0045	1 1/2	Red	36	2 15
Cotton Tape, linen finish	.007	1 1/2	Black	36	1 80
Cotton Tape, linen finish	.007	1 1/2	Red	36	1 80
Cotton Tape, linen finish	.007	1 1/2	White	36	1 35
Cotton Tape, linen finish	.007	1 1/2	Red	36	1 80
Cotton Tape, linen finish	.007	1 1/2	White	36	1 85
Cotton Tape, linen finish	.007	1	White	36	2 05
Cotton Tape, linen finish	.007	1 1/2	White	36	3 05
Surgical Tape	.020	1 1/2	White	36	2 70
Surgical Tape	.020	1	White	36	3 75
Surgical Tape	.020	1 1/2	White	36	4 80
Surgical Tape	.020	1 1/2	White	36	5 35
Surgical Tape	.020	2	White	36	6 90
Surgical Tape	.020	2 1/2	White	36	7 85
Surgical Tape	.020	2 1/2	White	36	8 85
Surgical Tape	.020	2 1/2	White	36	9 80

One gross yards equals 144 lineal yards.



4-CORD MACHINE THREAD

Cord and Thread

Material	Thickness Inches	Approx. Lbs. Per Ball or Reel	Approx. Yds. Per Lb.	List Price Per Pound
Elm Flax Thread	1/8	1	290	\$1 50
No. 3 Barbour's Flax Twine	1/8	1	3600	5 00
Four-Cord Machine Thread	1/8	1	900	2 75
Torpedo Twine	1/8	25	286	1 30
Torpedo Twine	1/8	25	146	1 30
Torpedo Twine	1/8	25	76	1 30
Wax End	1/8	1	900	4 40

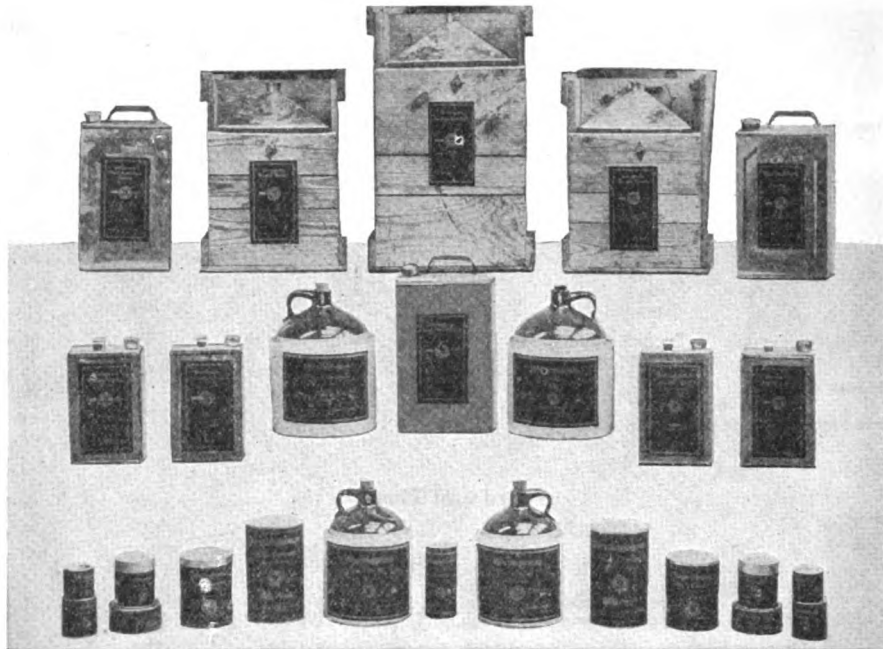
Asbestos

Material	Thickness Inches	How Furnished	Approx. Weight	List Price
Asbestos Cloth	.035	Sheets, 36"x36"	6 1/2 lbs. per sheet	\$5 35 per lb.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	24 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	33 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	43 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	54 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	65 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	87 per sq. ft.
Asbestos Lumber (white)	1/8	Sheets, 42"x96"	.....	1 30 per sq. ft.
Asbestos Lumber (white)	1	Sheets, 42"x96"	.....	1 75 per sq. ft.
Asbestos Sheet	.007	Rolls, 36" wide	110 lbs. per roll	29 per lb.
Asbestos Sheet	.010	Rolls, 36" wide	110 lbs. per roll	29 per lb.
Asbestos Sheet	.015	Rolls, 36" wide	110 lbs. per roll	18 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	3 1/2 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	6 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	10 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	13 1/2 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	18 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	24 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	34 lbs. per sheet	08 1/2 per lb.
Asbestos Sheet	1/8	Sheets, 42"x48"	46 lbs. per sheet	08 1/2 per lb.
Asbestos Tape	.015	1 1/2" wide, 21-yd. rolls*	4 oz. per roll	4 80 per lb.
Asbestos Tape	.015	1 1/2" wide, 21-yd. rolls*	5 1/4 oz. per roll	4 80 per lb.
Asbestos Tape	.015	1" wide, 21-yd. rolls*	10 oz. per roll	4 80 per lb.
Asbestos Tape	.015	1 1/2" wide, 21-yd. rolls*	12 oz. per roll	4 80 per lb.
Asbestos Tape	.025	1 1/2" wide, 21-yd. rolls*	20 oz. per roll	4 35 per lb.
Asbestos Tape	.025	1 1/2" wide, 21-yd. rolls*	26 oz. per roll	4 35 per lb.
Asbestos Tape	.025	1 1/2" wide, 21-yd. rolls*	2 lbs. per roll	4 35 per lb.
Asbestos Tape	.025	1 1/2" wide, 21-yd. rolls*	2 lbs. per roll	4 35 per lb.
Asbestos Tape	.025	1 1/2" wide, 21-yd. rolls*	2 1/2 lbs. per roll	4 35 per lb.
Asbestos Cord	1/8	5-lb. rolls	600 ft. per pound	6 50 per lb.
Asbestos Sleaving	1/8 nominal inside dia.	5-lb. rolls	175 ft. per pound	6 50 per lb.

\*Approximate number of yards per roll.

## INSULATING AND SOLDERING COMPOUNDS

### VARNISHES, SHELLACS, PAINTS, CEMENTS, GLUE AND SWITCH OIL



The selection of the proper insulating compounds is one of the most difficult phases of insulation application, and the user of insulation who does not have the facilities for making elaborate tests should consider carefully, besides the ability of a manufacturer to produce these compounds, his opportunities for determining the adaptability of any compound to a given service. The materials listed here are those used most extensively in the manufacture of the Westinghouse electrical apparatus. By using these materials the customer avails himself of the great amount of research work done in this Company's laboratories and also of the vast experience of this Company's engineers in the actual use of insulating materials.

#### Baking Varnishes

**Westinghouse No. 311 Varnish (Amber Insulator)** is a clear, amber colored, baking varnish, which possesses high dielectric strength, and exceptionally long life under continued heat. It is acid, oil and moisture resisting. It has good penetration and will bake dry to a considerable depth, at the same time forming a hard tough film on the surface. This feature makes the varnish an exceptionally good one for insulating transformer, ignition, field, and armature coils. It is also used for weather-proofing Micarta, fibre, and wood, and can be used for a protective coating on metal. It can be applied by brushing, dipping or spraying. It bakes in 8 to 10 hours at 110° to 120° Centigrade on cloth, or in one

hour on metal. The varnish should be thinned with 54°—56° naphtha.

**Westinghouse No. 315 Varnish** is a clear varnish which is similar to Westinghouse No. 311 varnish, but possesses longer life and greater durability. It is exceptionally tough and flexible and is designed especially for apparatus which is subjected to severe service and weather conditions. This varnish is recommended for marine apparatus, where several coats of varnish are applied. It can be applied by brushing or dipping, but dipping is recommended for uniform and effective sealing. It will bake in 8 to 10 hours at 110° to 120° Centigrade. 54°—56° naphtha should be used for thinning.

**Westinghouse No. 319 Varnish (Black Asphaltum Enamel)** is a high grade, black, baking varnish which can be used for either insulating or finishing purposes. It produces a glossy, tough, flexible film, and, when baked at high temperatures, a bone-hard film which will withstand severe service. It is acid, oil, moisture and weather-resisting, and possesses very high dielectric strength. When used as an insulator, it will bake in 8 to 10 hours at 110° to 120° Centigrade, and is useful for dipping coils, and Micarta tubes. When used as a finishing varnish it will bake in 2 to 3 hours at 170° to 180° Centigrade, and, because of its brilliant and elastic film, is an excellent finish for apparatus such as small motor frames.

**Westinghouse No. 327 Varnish (Plastic Insulator)** is a black baking varnish which produces a firm, tough, and elastic film. It is especially useful as an

## INSULATING AND SOLDERING COMPOUNDS—Continued

insulating varnish where heat and vibration are encountered. It is acid, alkali fume, and moisture resisting and possesses high dielectric strength. It has good penetration and excellent filling properties, and is therefore a good varnish for treating duck, tape, or paper, or for sealing between layers of tape. It is especially adapted for field coils for railway or mine use. This varnish will bake in 8 to 10 hours at 110° to 120° Centigrade, and should be thinned with 54°—56° naphtha.

**Westinghouse No. 335 Varnish** is a high grade, **black**, baking varnish, with extra good flexibility and ageing qualities. It is a good insulator and produces a tough, glossy film which is both hard and elastic. It will not soften under temperatures above the average, and will allow for maximum expansion and contraction without cracking. It is impervious to hot oil, and resists acid and alkali fumes. This varnish is recommended for armature, ignition, and other coils which operate under severe service; and for apparatus which is subjected to oil. It bakes in 12 to 14 hours at 110° to 120° Centigrade, but longer baking produces a harder film. Thin with 54°—56° naphtha.

**Westinghouse No. 337 Varnish** is a **black** baking varnish designed and constructed for exceptional service under extreme operating conditions. It produces a tough, fairly hard, flexible film, has excellent filling qualities, and has a high insulating value. On account of its exceptional qualities it is recommended for coils and wound apparatus which operate in sump holes or chemical and acid plants. Best results are obtained when three or more coats are applied. This varnish can be applied by brushing or dipping and will bake in 12 to 14 hours at 110° to 120° Centigrade. Thin with 54°—56° naphtha.

**Westinghouse No. 343 Varnish** is a quick baking, flashing varnish used for insulating sheet steel laminations. It is flexible even when baked at high temperatures. Has good insulating qualities and is not affected by hot oil. It will withstand high temperatures indefinitely and will not become volatile. This varnish can be applied by spraying, but is usually used in connection with a coating machine. It can be flashed on, or it will bake in an oven at 250° to 275° Centigrade in 6 to 10 minutes. It is thinned with 54°-56° naphtha.

### Air Drying Varnishes

**Westinghouse No. 410 Varnish** is a **clear** varnish, which air-dries in 4 to 6 hours, forming a hard, moderately flexible film. It has high dielectric strength and, for an air-drying varnish, long life under heat. It resists acid and alkali fumes and moisture. Thin with 54°—56° naphtha.

**Westinghouse No. 416 Varnish (Air Drying Insulator)** is a glossy, **black**, quick air-drying varnish which can be used as an insulator or finish. It has high dielectric strength, will resist fairly well acid and alkali fumes, and dries with a hard, lustrous film. It is used extensively when a baking varnish is not practical, and in repair shops where baking facilities are not available. It is also used as a finishing coat on wound apparatus and can be used for finishing laboratory apparatus. It will air-dry in 2 to 4 hours and should be thinned with 54°—56° naphtha. It can be applied by dipping, brushing or spraying.

**Westinghouse No. 418 Varnish (Black Insulating Varnish)** is a **black**, glossy, quick air-drying varnish possessing exceptional insulating qualities and producing a tough, elastic film. It resists acid and alkali fumes, is a moisture repellent and will not become brittle on ageing. It will dry in one hour or less and adheres firmly to all materials. When baked for 3 to 4 hours at 110° to 120° Centigrade, it will not soften at ordinary temperatures. It is used for dipping stators, strap coils, and connectors, and where a baking varnish is unnecessary. It can be applied by brushing, dipping or spraying and is thinned with gasoline or benzol.

**Westinghouse No. 422 Varnish (Black Finishing Varnish)** is a glossy, **black**, quick air-drying varnish, which is oil-proof and a high grade insulator, It produces a hard, smooth surface which affords protection against dirt and dust. It is used for general finishing purposes on electrical apparatus, and can be applied by brushing, dipping or spraying, Westinghouse No. 436 Varnish or denatured alcohol is used for thinning.

**Westinghouse No. 428 Varnish (No. 3 Shellac)** is an **orange**, heavy bodied, quick-drying varnish, which is used for general insulating purposes. It is also used for sticking and building up paper and cloth, and for cementing asbestos and other sheet insulation to wood or metal. It is used in many ways as a finishing varnish for sealing pores and smoothing rough surfaces. It can be applied by brushing, dipping, or spraying. It is thinned with Westinghouse No. 436 Varnish or denatured alcohol.

**Westinghouse No. 434 Varnish (No. 14 Shellac)** is a **clear**, transparent, quick-drying, spirit varnish, which produces a hard, glossy, film having a fair amount of flexibility. It is oil-proof and moisture resisting. Its uses are similar to those of No. 428 Varnish. Thin with Westinghouse No. 436 Varnish or denatured alcohol.

**Westinghouse No. 436 Varnish (No. 1 Shellac)** is a specially prepared, light-bodied, spirit varnish used chiefly as a thinner for heavier spirit varnishes. Being thus prepared it is less subject to the variations found in commercial denatured alcohol.

## INSULATING AND SOLDERING COMPOUNDS—Continued

## Insulating Compounds

**Westinghouse No. 513 Compound (No. 5 or Commutator Cement)** is an acid free, quick-setting compound which possesses excellent mechanical strength and insulating qualities. This compound will withstand injury from contraction and expansion and will not crumble or burn under ordinary temperatures. It consists of a powder and liquid packed separately in a container. This compound is used for repairing pitted commutators, and for filling-in purposes on the front and rear ends of armatures. This compound will set in air in 24 hours, but large masses should be heated at 60° to 70° Centigrade for 4 to 5 hours, to assure complete drying. Best results are obtained when the compound is used in proportions of 3 parts powder to 1 part liquid.

**Westinghouse No. 517 Compound**—This compound is the liquid required for use with Compound No. 513 and can be ordered separately.

**Westinghouse No. 521 Compound (A.R.C. Cement)** is a compound especially designed to withstand temperatures up to 800° or 900° Centigrade. It is exceptionally well fitted for repairing arc deflectors and arc chutes, rheostats, asbestos lumber, stone, porcelain, and other heat-resisting materials. It is applied cold like putty, and air-dries in 10 to 12 hours; or will bake dry in 3 to 4 hours at 200° Centigrade.

**Westinghouse No. 525 Compound (No. 18 Cement)** is a hard, oil-proof filling compound used for filling around transformer leads and bushings, for sealing pot-heads and terminal bells, and other applications where an oil-proof sealing compound is required. It has a dropping point of 140° Centigrade, and flows readily at 160° Centigrade. This compound shrinks 5 per cent on cooling from 150° to 20° Centigrade.

**Westinghouse No. 529 Compound** is a non-oil-proof, tough, flexible filling compound used for filling joints, pot-heads, junction boxes, and other applications where a non-oil-proof filling compound is required. It is also used for protecting underground cable or where extreme moisture protection is required. This compound has a dropping point of 140° Centigrade, flows readily at 150° Centigrade, and shrinks approximately 12 to 15 per cent on cooling from 150° to 20° Centigrade.

**Westinghouse No. 533 Compound** is a hard sealing and filling compound, red in color, used for filling over screw heads in porcelain and slate bases of switch panels. It is a good insulator and is moisture proof. It has a dropping point of 110° Centigrade, and flows readily at 120° Centigrade.

**Westinghouse No. 535 Compound** is a black wax compound used for filling cable joints, and similar applications, where easy removal of the compound is desirable. It is also used for filling junction boxes and pot heads. This compound has a "sharp" melting point, that is, the compound will

not soften until a temperature is reached which is but slightly lower than the melting point.

**Westinghouse No. 539 Compound** is an amber impregnating compound which is exceptionally free from dirt and foreign matter. It has excellent insulating properties, is water-proof, and is not affected by hot oil. It has a dropping point of 110° to 120° Centigrade, and when heated to 150° Centigrade is very fluid and penetrates well. It has a "sharp" point and drains well from the apparatus. This compound is recommended for use in vacuum-impregnating transformers.

**Westinghouse No. 541 Compound** is a specially prepared thinner for use in maintaining a uniform dropping point for No. 539 Compound.

**Westinghouse No. 543 Compound** is a black asphaltic compound, recommended for use in connection with No. 547 Compound for impregnating railway field coils. It is fairly tough and resilient and possesses good insulating qualities. It requires a voltage of 320 volts per mil. to puncture. It can also be used for filling purposes where a low temperature non-oil-proof compound is required. It has a dropping point of 90° Centigrade and flows readily at 110° Centigrade. On cooling from 120° to 20° Centigrade it shrinks approximately 15 per cent.

**Westinghouse No. 547 Compound** is a black asphaltic compound similar to No. 543 Compound, but having a higher dropping point. It drops at 150° Centigrade, flows readily at 170° Centigrade, and shrinks approximately 20 per cent on cooling. Its dielectric strength is 320 volts per mil. of thickness. When mixed with No. 543 Compound, any desired dropping point can be obtained by varying the proportions. Its tough rubbery structure makes this compound an excellent non-oil-proof filling compound.

## Finishing Materials

## Air Drying

**Westinghouse No. 614 Priming Paint** is a specially prepared, black, iron primer containing linseed oil, white lead, and a coloring pigment. This priming paint has good adherence and forms an excellent foundation for black finishing paints. It will not craze, crack nor shrink. It will dry in 8 to 10 hours. This primer is recommended for painting apparatus for indoor service.

**Westinghouse No. 618 Priming Paint** is a high grade, light brown primer, especially designed for the first coat in finishing apparatus for outdoor service. This primer contains a lead base, ground in reinforced pure linseed oil, and thinned with specially prepared paint thinner. This primer can be applied to iron or other metal, and also to galvanized surfaces. It will not "alligator" nor crack. This primer will dry dust-free in 8 hours, but should dry 24 hours before any other paint is applied. It



## INSULATING AND SOLDERING COMPOUNDS—Continued

can be brushed, dipped, or sprayed. It is shipped for brushing and should be thinned if necessary with Westinghouse No. 662 Paint Thinner.

**Westinghouse No. 622 Paint** is a light gray paint and is used as a second coat over Westinghouse No. 618 Priming Paint. It is designed to create a closer union between the primer and finishing coats of paints. It contains the same high grade materials as are in Westinghouse No. 618 Priming Paint, and a greater proportion of oil. It will dry in 8 hours, but 24 hours should be allowed before the finish is applied.

**Westinghouse No. 626 Paint** is a high grade, dark gray finishing paint, which is the standard Westinghouse outdoor finish. This paint is long in oil, and dries with a hard glossy film. It is especially adapted for outdoor service and will not crack, craze, or shrink. When used in connection with Westinghouse No. 618 Primer and Westinghouse No. 622 Second Coat Paint this paint forms an exceptionally durable paint film. It can be applied by dipping, brushing, or spraying. It should be thinned with Westinghouse No. 662 Paint Thinner. It dries dust free in 10 to 12 hours. This paint can also be baked in 6 to 8 hours at 70° to 80° Centigrade and will not change color.

**Westinghouse No. 630 Sealer** is a black, quick-drying sealer-coat paint, which dries with a hard impervious film. It is used over a priming paint to insure equal absorption and the consequent uniform gloss in the finish. It will dry in 4 to 6 hours and is shipped ready to apply by brushing.

**Westinghouse No. 634 Enamel** is a black, semi-gloss enamel which produces a velvet finish. When used in connection with No. 630 Sealer it makes an ideal finish for machines. It is oil proof. This enamel is applied only by brushing.

**Westinghouse No. 638 Enamel** is a light gray enamel which is specially designed to withstand mineral oil. It is used to paint oil wells and housings for bearings. It is an excellent paint to resist weather and heat.

**Westinghouse No. 642 Enamel** is a glossy black, fairly quick-drying, oil-proof enamel which can be applied to apparatus which operates in oil. It dries in 4 to 6 hours and can be used without a primer. It is applied by brushing or spraying and is shipped ready for use.

**Westinghouse No. 646 Enamel (Flat Black Enamel)** is a flat black enamel which dries in 2 to 4 hours. It is oil proof and a good insulator. It can be used for finishing castings and the backs of switchboards. This enamel is applied by brushing and can be thinned with turpentine or petroleum naphtha.

**Westinghouse No. 650 Paint (Protective Paint)** is a glossy black paint which dries with a tough, elastic film. It is used on metal surfaces only and affords protection against moisture and acid and

alkali fumes. It is applied by brushing or dipping and is thinned with petroleum naphtha.

**Westinghouse No. 654 Japan** is a black, medium grade japan which affords good protection for metal surfaces. It dries with a high gloss and is not easily chipped off. It can be applied by brushing, dipping, or spraying.

**Westinghouse No. 658 Lacquer (Switchboard Lacquer)** is a black, quick-drying, velvet-finish enamel which produces the so-called marine finish. This enamel will adhere to any material and is an excellent insulator. It is water-proof and is not affected by oil or the ordinary solvents. Best results are obtained by spraying the enamel. It is thinned with Westinghouse No. 664 Thinner. It will dry hard in one hour or may be baked at 50° Centigrade for 30 minutes.

**Westinghouse No. 662 Paint Thinner** is a well balanced thinner containing selected solvents and driers with the necessary binder. It is clear and will not leave a residue upon evaporation.

**Westinghouse No. 664 Thinner (Lacquer Thinner)** is a special thinner for use only with Westinghouse No. 658 Lacquer Enamel.

## Baking

**Westinghouse No. 718 Japan** is a black, glossy japan which affords a reasonably cheap protective coating. It is used on tanks and other apparatus where a high grade finish is not essential. It will bake in 3 hours at 150° Centigrade. 54°—56° naphtha is used for thinning.

**Westinghouse No. 722 Japan** is a high grade, black, rubber finish japan. This japan bakes with a rich lustrous finish, and is exceptionally durable. It will bake in 3 to 4 hours at 150° to 160° Centigrade. It is thinned with 54°—56° naphtha.

**Westinghouse No. 732 Enamel** is a black, semi-gloss enamel which bakes hard at a low temperature. It is an excellent insulator and is recommended for finishing switch handles and cross bars. It will bake in 12 to 14 hours at 90° to 100° Centigrade. This enamel should be used as received.

**Westinghouse No. 736 Enamel** is a glossy black, high grade enamel suitable for all metal surfaces. It is exceptionally hard and tough and will withstand severe service. It will bake in 3 to 4 hours at 150° to 160° Centigrade, or for longer periods at lower temperatures where insulation is present. 54°—56° naphtha is used for thinner.

## Insulating Glue

**Westinghouse No. 880 Glue (Insulating Glue)** is a non-hygroscopic, neutral, liquid insulating glue, possessing excellent adhesive qualities. Applied cold it is recommended for fastening tape ends, closing cells and in general for gluing insulating materials. It can also be baked, and is recommended for building up fuller board strips.

INSULATING AND SOLDERING COMPOUNDS—Continued

Soldering Flux

**Westinghouse No. 908 Flux** is a high grade, neutral, liquid soldering flux, to be applied by brushing or dipping. It dries quickly and is fairly adhesive. It can be used as a protective coating for parts in storage, which are later to be tinned or soldered. Thin with alcohol.

**Westinghouse No. 914 Flux (Soldering Paste)** is a medium grade soldering flux, ready for use. It is in easily applied paste form. It acts as a cleaner and flux, and causes the solder to flow well, thereby making a firm lasting joint.

**Westinghouse No. 920 Flux** is a high grade flux in paste form similar to No. 914 Flux. This flux is acidless and is for use with fine wire, or where high insulation is required.

HL Lubricating Oil

HL Oil was developed for the lubrication of Westinghouse pneumatically-operated switch cylinders.

This oil is sufficiently liquid to be used in an ordinary oil can and is used without dismantling switch group. Inject through the hole in the top of switch cylinder casting, 1/8 ounce (one teaspoonful) every 10,000 miles (under average operating conditions). Should pistons get gummy, use more frequently, but only amount necessary for free operation.

HL Oil should also be used during the heavy overhaul, when pistons are removed from cylinders. Cylinder and piston should be coated well with this oil. Approximately 1/4 ounce is required for each cylinder.

PRICES

Baking Varnishes

	COLOR	*SPECIFIC GRAVITY	APPLICATION	THINNER	LIST PRICE PER GALLON			
					In 1-Gal. Cont.	In 5-Gal. Cont.	In 10-Gal. Cont.	In 1-Bbl. Cont.
No. 311 Varnish (Amber Insulator)	Clear	.850	Bakes in 8 hrs. at 110°-120° C.	54°-56° Naphtha	\$2 15	\$2 05	\$1 85	\$1 55
No. 315 Varnish	Clear	.835	Bakes in 8 hrs. at 110°-120° C.	54°-56° Naphtha	2 90	2 80	2 70	2 40
No. 319 Varnish (Asphaltum Enamel)	Black	.855	Bakes in 8 hrs. at 110°-120° C. or in 2 to 3 hrs. at 170°-180° C.	54°-56° Naphtha	2 05	1 95	1 65	1 35
No. 327 Varnish (Plastic Insulator)	Black	.850	Bakes in 8 hrs. at 110°-120° C.	54°-56° Naphtha	1 60	1 50	1 35	95
No. 335 Varnish	Black	.865	Bakes in 12 to 14 hrs. at 110°-120° C.	54°-56° Naphtha	2 40	2 35	2 30	1 85
No. 337 Varnish	Black	.850	Bakes in 12 to 14 hrs. at 110°-120° C.	54°-56° Naphtha	1 70	1 60	1 55	1 20
No. 343 Varnish	Black	.830	Flashes or bakes in 6 to 10 min. at 250°-275° C.	.....	1 95	1 85	1 75	1 35

Air Drying Varnishes

No. 410 Varnish	Clear	.850	Air-dries in 4 to 6 hrs.	54°-56° Naphtha	2 45	2 35	2 25	1 90
No. 416 Varnish (Air Drying Insulator)	Black	.850	Air-dries in 2 to 4 hrs.	54°-56° Naphtha	1 90	1 75	1 50	1 15
No. 418 Varnish (Insulation Varnish)	Black	.900	Air-dries in 1 hr. Bakes in 3 to 4 hr. at 110°-120° C.	Gasolene or Benzol No. 436	3 40	3 30	3 15	2 70
No. 422 Varnish (Finishing Varnish)	Black	.916	Air-dries in 1 hr.	Var. or denatured alcohol No. 436	3 60	3 45	3 30	2 95
No. 428 Varnish (No. 3 Shellac)	Orange	.880	Air-dries in 30 minutes	Var. or denatured alcohol No. 436	4 65	4 35	4 25	3 80
No. 434 Varnish (No. 14 Shellac)	Clear	.845	Air-dries in 30 minutes	Var. or denatured alcohol No. 436	2 00	1 90	1 85	1 60
No. 436 Varnish (No. 1 Shellac)	Clear	....	.....	Var. or denatured alcohol	2 45	2 35	2 15	1 75

Insulating Compounds

	Color	Dropping Point	Characteristics	Container	List Price
No. 513 Compound (No. 5 or Commutator Cement)	White	.....	Insulating filler will air-dry in 24 hrs. or bake in 5 hrs. at 60° to 70° C.	1/4-lb. Can 3-lb. Can 10-lb. Can 25-lb. Can	Per lb. \$0 90 Per lb. 49 Per lb. 30 Per lb. 25 Per gal. 4 65
No. 517 Compound No. 521 Compound (A.R.C. Cement)	White	.....	Heat resisting filler will air-dry, or bake 3 hrs. at 200° C.	1-pt. Can 1-qt. Can 1-gal. Can	Per can 38 Per can 65 Per can 2 05
No. 525 Compound (No. 18 Cement)	Black	140° C.	Oil-proof Fluid at 160° C.	1-lb. Cakes 10-lb. Cakes	Per lb. 15 Per lb. 15

\*The information given with regard to thinners and specific gravities is based upon our experience with the products. The specific gravities given are the recommended densities for applying. The product furnished may not have this density.

INSULATING AND SOLDERING COMPOUNDS—Continued

PRICES—Continued

Insulating Compounds—Continued

	Color	Dropping Point	Characteristics	Container	List Price
No. 529 Compound	Black	140° C.	Non-oil-proof Fluid at 150° C.	1-lb. Cakes 10-lb. Cakes	Per lb. \$0 15 Per lb. 15
No. 533 Compound	Red	110° C.	Non-oil-proof filling compound	.....	Per lb. 15
No. 535 Compound	Black	75° C.	Non-oil-proof Easily removed	.....	Per lb. 30
No. 539 Compound	Amber	110°-120° C.	Oil-proof	.....	Per lb. 45
No. 541 Compound	.....	.....	.....	.....	Per gal. 1 50
No. 543 Compound	Black	90° C.	Non-oil-proof	.....	Per lb. 10
No. 547 Compound	Black	150° C.	Fluid at 110° C.	.....	Per lb. 10

Air-Drying Finishing Materials

	Color	*Specific Gravity	Application	Thinner	LIST PRICE PER GALLON			
					In. 1-Gal. Cont.	In. 5-Gal. Cont.	In. 10-Gal. Cont.	In. 1-Bbl. Cont.
No. 614 Priming Paint	Black	.....	Air-dries in 8 hrs.	No. 662	\$3 70	\$3 60	\$3 50	\$3 15
No. 618 Priming Paint	Lt. Brown	.....	Air-dries in 8 hrs.	No. 662	5 30	5 20	5 10	4 65
No. 622 Paint	Lt. Gray	.....	Air-dries in 8 hrs.	No. 662	5 30	5 20	5 10	4 65
No. 626 Paint	Dr. Gray	.....	Air-dries in 8 hrs.	No. 662	5 30	5 20	5 10	4 65
No. 630 Sealer	Black	.....	Air-dries in 4 to 6 hrs.	Use as received	4 80	4 70	4 60	4 25
No. 634 Enamel	Semi-Glossy	.....	Air-dries in 6 to 8 hrs.	Use as received	5 30	5 20	5 10	4 65
No. 638 Enamel	Black	.....	Air-dries in 12 to 14 hrs.	No. 662	5 60	5 50	5 40	5 05
No. 642 Enamel	Lt. Gray	.....	Air-dries in 4 to 6 hrs.	Use as received	3 80	3 70	3 60	3 25
No. 646 Enamel (Flat Black Enamel)	Black	.....	Air-dries in 2 to 4 hrs.	Naphtha or Good insulator	4 30	4 25	3 80	3 45
No. 650 Paint (Protective Paint)	Glossy	.....	Air-dries in 8 to 10 hrs.	Naphtha	1 80	1 70	1 45	1 00
No. 654 Japan	Black	.....	Air-dries in 6 to 8 hrs.	Naphtha	1 30	1 25	1 15	80
No. 658 Lacquer (Switchboard Lacquer)	Black	.....	Air-dries in 1 hr.	No. 664	6 50	6 45	6 30	.....
No. 662 Paint Thinner (Lacquer Thinner)	.....	.....	.....	.....	1 75	1 65	1 55	1 15
No. 664 Thinner (Lacquer Thinner)	.....	.....	.....	.....	5 60	5 50	.....	.....

Baking Finishing Materials

No.	Color	Specific Gravity	Bakes in	Thinner	1 1/2-pt. Can	1-qt. Can	1-gal. Can	1-bbl. Can
No. 718 Japan	Black	.855	Bakes in 3 hrs. at 150°-160° C.	Naphtha	1 50	1 40	1 30	1 00
No. 722 Japan	Black	.900	Bakes in 3 to 4 hrs. at 150° to 160° C.	Naphtha	4 70	4 60	4 50	4 15
No. 732 Enamel	Black	1.06	Bakes 14 hrs. at 90° to 100° C.	Naphtha	4 10	4 00	3 90	3 50
No. 736 Enamel	Black	8.35	Bakes 3 to 4 hrs. at 150° to 160° or less	Naphtha	3 35	3 30	3 20	2 80

Insulating Glue

No. 880 Glue (Insulating Glue).....	LIST PRICE PER CAN		
	1/2-Pint Can	1-Quart Can	1-Gallon Can
	\$0 26	\$0 55	\$1 70

Soldering Fluxes

No. 914 Flux (Soldering Paste)..... No. 920 Soldering Flux.....	LIST PRICE PER CAN			
	2-oz. Can	4-oz. Can	8-oz. Can	1-Lb. Can
	\$0 16	\$0 18	\$0 29	\$0 45
	25	40	70	1 25
				9 00

No. 908 Soldering Flux.....	LIST PRICE PER CAN		
	1-pt. Can	1-qt. Can	1-gal. Can
	\$0 26	\$0 39	\$1 30

Lubricating Oil

HL Oil (in one-gal. can which weighs seven pounds).....	List Price
	\$0 18 per lb.

\*The information given with regard to thinners and specific gravities is based upon our experience with the products. The specific gravities given are the recommended densities for applying. The product furnished may not have this density.  
†In ordering specify about one-half as much No. 664 Thinner (Lacquer Thinner) as Lacquer.

## INSULATING OILS

The oils listed in this section are of the highest quality and are the kind used in all Westinghouse apparatus requiring an insulating oil. A great amount of research work has been done by the Com-

pany in this line and the oils listed are the result. The purchaser can, therefore, feel assured that the material described is the best of its kind obtainable for the purpose.

### WEMCO A TRANSFORMER OIL

#### General

Wemco A oil is a special grade of oil for use in oil-insulated and oil-cooled apparatus, including transformers, Westinghouse indoor oil circuit-breakers, electrolytic lightning-arresters, feeder-regulators, and rectifiers. For Westinghouse oil circuit-breakers, Wemco A oil should not be used where temperatures below 0 degrees Centigrade (32° Fahrenheit) might be encountered, as in unheated indoor or in outdoor installations. For such applications Wemco C oil should be used. Careful research has demonstrated that Wemco A oil is entirely suitable for use in oil-circuit-breakers, where the temperature limitations referred to above permit. This allows the use of one grade of oil in all oil-immersed apparatus, except where exposed to low temperatures.

It is desirable that oils which have been used in transformers, and oils which have been used in circuit-breakers, should not be mixed to be used again. However, if it is necessary to use in a transformer, oil that has been previously used in a circuit-breaker, this oil should first be thoroughly cleaned. This is to rid it of free carbon or any other impurity which may have been caused by the operation of the circuit-breaker and which, while harmless to the circuit-breaker, may be injurious to the transformer.

It is a pure mineral oil free from moisture, acids alkali or free sulphur and is very fluid. This oil is not affected by high temperatures reached under operating conditions. It congeals at minus 2 degrees Centigrade (28.4 degrees Fahrenheit.)

#### Insulating Properties

**Dielectric Strength**—This oil has an average breakdown value of 22,000 volts when tested in the method described in the first paragraph following.

**Methods of Test**—The usual method of testing Wemco A Oil is by the use of our oil testing cup, Style No. 263621 (see page on Oil Testing Cups), which is a device having flat disc electrodes one inch in diameter with square edges, set with surfaces in parallel planes 0.1 inch apart and with their axes in the same horizontal line.

A similar device may be used with discs 0.5 inch

in diameter set 0.2 inch apart: the average breakdown value must then be not less than 38,500 volts.

A third device having electrodes consisting of spheres 0.5 inch in diameter set 0.15 inch apart in the same vertical line may be used; the average breakdown voltage with this device must not be less than 40,000 volts.

The following precautions must be followed when using all devices for making dielectric tests, to prevent obtaining results that will cause the condemnation of good oil.

When possible the gap should first be adjusted and locked in place. Then rinse thoroughly with benzine or gasoline. If wiping with cloth is necessary, the cloth must be dry and all such cleaning must be followed by thorough rinsing until all fibers of cotton have been eliminated. Then give a final rinsing with the oil to be tested, immediately before placing the test sample in the apparatus.

The temperatures of both oil and testing apparatus should be as nearly the same as possible and should be between 20 degrees Centigrade and 30 degrees Centigrade. Lower temperatures are likely to yield low break-down values and higher temperatures high values.

The oil level for apparatus with disc electrodes should not be less than one inch above the electrodes and for apparatus with spheres arranged above one another not less than six inches above the center of the gap.

The testing transformer should have a capacity at least one kilovolt-ampere.

Pour the test sample into the testing device and allow it to stand until all minute air bubbles have had time to escape. This will require two or three minutes.

Apply the testing voltage, starting at a low value and increasing steadily at the rate of about 3000 volts per second without opening the circuit until breakdown takes place.

After each break, jar the testing device but do not cause the oil to be agitated sufficiently to take up air bubbles. This will tend to loosen particles of carbonized oil from between the electrodes. Do not introduce any device into the oil for stirring, as it is likely to cause low breakdown voltages on

## INSULATING OILS—Continued

account of introducing minute particles of foreign matter or moisture. Jarring will not remove all carbon from between the electrodes, but the remainder will be driven off by the next application of voltage before the breakdown value is reached.

Repeat the application of voltage until five breakdowns have been made and use the average value as the breakdown voltage of the oil.

Sometimes a small bright spark passes across the gap but does not form an arc or cause circuit breakers or fuses to open the circuit. Such discharges should be disregarded in recording results. They are not likely to occur if sufficient time is allowed for all air to escape before applying voltage. It is better to make tests on several samples of oil if the first sample has a low breakdown value. If the tests on any one sample from the same tank, or other container, yield satisfactory results, and the tests on other samples are low, the latter may be disregarded as having been caused by contamination while taking from the container or by insufficient cleaning of the testing device.

**Moisture**—It is imperative that the oil contain little or no moisture, as the dielectric strength of the oil decreases very rapidly as the percentage of moisture increases. Various grades of oil differ greatly as to their abilities to separate from water with which they have been mechanically mixed. Wemco A oil possesses this separating property to a marked degree. If mixed with a large percentage of water and the water be allowed to settle over a considerable period, the Wemco A oil will, without other treatment, regain a large percentage of its original dielectric strength.

**Chemical Reaction**—The presence of traces of acid or of alkali used in the purification of oil of this class is not permissible in insulating oil for two reasons: first, the presence of the acid or alkali reduces the dielectric strength of the oil; and, second, acids and alkali are corrosive or destructive in their action upon the materials of the apparatus.

**Physical Properties**

**Viscosity**—Since one of the main functions of the oil is to cool the apparatus it insulates, its viscosity is of great importance. The more sluggish the oil the slower will be its circulation, and consequently the transfer of heat will be correspondingly slow. Heavy oil will not circulate freely through the oil ducts of the windings with the result that a high temperature gradient exists between the oil and the transformer or other windings. The viscosity of Wemco A oil is approximately 50 at 40 degrees Centigrade (104 degrees Fahrenheit). The viscosity is determined by the time required to flow

out of a given vessel through an orifice of specified dimension. (Saybolt Universal Viscosimeter.)

**Deposit**—A transformer or switch oil should be as free from deposit as possible. This deposit is objectionable principally because it clings to the coil winding, fills the oil ducts of transformers, and adheres to the contacts of oil circuit-breakers. The cooling of the apparatus is thus seriously affected by oil which forms a deposit under normal conditions. The deposit also renders the oil more sluggish and thus further affects its cooling action. The deposit is an indication that a chemical decomposition is taking place and is therefore an important matter. The forming of deposit seems to be a matter of the temperature at which the oil operates and the length of time it has been used. Different grades of oil differ as to the temperature at which deposit will appear. The characteristics of Wemco A oil are particularly good as regards deposit, and no trouble will be experienced under any condition of normal operation.

**Flash Point and Fire Point**—The flash point of oil is the temperature at which the vapor resulting from the heat ignites; and the fire-point is the temperature at which the oil actually takes fire.

The flash-and fire points should be well above any temperatures that might occur in the oil under operating conditions.

The maximum temperature of the oil should never be allowed to exceed 90 degrees Centigrade (194 degrees Fahrenheit) in oil-insulated transformers or regulators, or 70 degrees Centigrade (158 degrees Fahrenheit) in oil circuit-breakers. Because of these operating limits, and because the oil does not ignite until a very high temperature is reached, it is evident that extremely high flash points and fire points are not necessary.

The flash point of Wemco A oil will not be less than 140 degrees Centigrade (284 degrees Fahrenheit) and the fire point not less than 154 degrees Centigrade (310 degrees Fahrenheit) when tested in open cup.

**Color**—The color of insulating oil is of relatively small importance, but a light color is desirable, so that the transformers or other apparatus may be inspected when under oil. It is also sometimes necessary to make changes on the terminal boards submerged below the oil level, or to inspect circuit-breaker contacts by means of periscopic devices. The lighter colored oil may permit doing this without lowering the oil level. Wemco A oil is very light in color.

**Specific Gravity**—The specific gravity of Wemco A oil is approximately 0.83.

## INSULATING OILS—Continued

## WEMCO B SWITCH OIL

Wemco B oil was the standard oil for use in Westinghouse indoor oil circuit-breakers for many years. Later research has demonstrated that wherever Wemco B oil has been used in Westinghouse oil circuit-breakers, Wemco A oil can be used instead. Thus the number of kinds of oil that a customer must carry in stock can be reduced. However, Wemco B oil is still available for customers who may want to maintain their present stock of it. Wherever necessary, Wemco A and Wemco B oils can be mixed for use in Westinghouse oil circuit-breakers. Because Wemco B oil is unsatisfactory for use in transformers, these two oils cannot be mixed for this use. The use of Wemco C oil is recommended where, as in unheated indoor or any outdoor insulation, temperatures below 0 degrees Centigrade (32 degrees Fahrenheit) might be encountered.

Wemco B oil is a pure mineral oil, free from moisture, acid, alkali, and free sulphur, and is not affected by high temperatures reached under operating conditions. It begins to congeal at minus 11 degrees Centigrade (12.2 degrees Fahrenheit).

The same methods of test are used for Wemco B oil as described for Wemco A oil.

**Dielectric Strength**—The oil has an average breakdown value of 18,000 volts when tested between flat

disc electrodes one inch in diameter set with surface in parallel planes 0.1 inch apart (see oil test cup, Style No. 263621). Tested in a similar device using one-half inch discs set 0.2 inch apart, the average breakdown voltage is 31,500 volts; or tested in device using one-half inch spheres set 0.15 inch apart, the average breakdown voltage is 35,000 volts.

**Viscosity**—Wemco B oil is somewhat heavier than Wemco A oil, the viscosity being about 71 (Saybolt test) at 40 degrees Centigrade (104 degrees Fahrenheit).

**Flash Point and Fire Point**—Wemco B oil has a flash point of not less than 171 degrees Centigrade (340 degrees Fahrenheit) and a fire point of not less than 198 degrees Centigrade (390 degrees Fahrenheit) when tested in an open cup.

**Deposit**—Wemco B oil has a very low deposit under any normal operating conditions.

**Evaporation**—The characteristic of low evaporation is of small importance in switch service. However, Wemco B oil under operating conditions will show only a very slight loss by evaporation.

**Color**—Wemco B Oil is light in color.

**Specific Gravity**—The specific gravity is about 0.86 at 15.5 degrees centigrade (60 degrees Fahrenheit).

## WEMCO C SWITCH OIL

Wemco C oil is similar to Wemco A oil but has the remarkably low congealing point of minus 40 degrees Centigrade (minus 40 degrees Fahrenheit). Wemco C oil is recommended for use the year round in outdoor or unheated indoor installations of oil circuit-breakers, switches and auto-starters when temperature below 0 degrees Centigrade may be encountered. In such service the congealing of the more viscous Wemco A oil might interfere with the operation of the apparatus. A low congealing temperature is not ordinarily important for outdoor-type transformers, or electrolytic lightning arresters, as the movement of contacts is not involved.

The general characteristics of Wemco C oil are similar to those for Wemco A oil.

Wemco C oil is a pure mineral oil, free from moisture, acid, alkali and free sulphur.

**Dielectric Strength**—Wemco C oil has an average breakdown value of 20,000 volts when tested between flat disc electrodes one inch in diameter set

with surfaces in parallel planes 0.1 inch apart (see oil test cup, Style No. 263621). Tested in a similar device using one-half inch discs set 0.2 inch apart the average breakdown voltage is 35,000 volts; tested in device using one-half inch spheres set 0.15 inch apart, the average breakdown voltage is 36,000 volts.

**Viscosity**—The viscosity is about 110 (Saybolt test) at 40 degrees Centigrade (104 degrees Fahrenheit).

**Flash Point and Fire Point**—Wemco C oil has a flash point of not less than 149 degrees Centigrade (300 degrees Fahrenheit) and a fire point of not less than 174 degrees Centigrade (345 degrees Fahrenheit) when tested in open cup.

**Deposit**—Wemco C oil has a very low deposit under any normal operating conditions.

**Evaporation**—Wemco C oil, under operating conditions, has only a very small loss by evaporation.

**Color**—Wemco C oil is light in color.

## OIL TESTING SERVICE



SAMPLE CONTAINER

It is of prime importance that insulating oils be kept free from water and other impurities. Tests have shown that as little as .005 per cent of moisture will reduce the dielectric strength of oil to half of its strength when dry. The curve below shows this effect.

Moisture may find its way into insulating oil in several ways. The oil is frequently shipped in metal drums, and if these are exposed to rain, moisture may enter around the threads of the bung, or through imperfections in the seams. In water-cooled transformers, the portions of the water pipes which extend above the oil level are always heavily lagged with a heat insulating material. If this lagging is damaged, moisture in the air inside of the transformer may be condensed on the cold water pipe and may run down into the oil. Another source to which the presence of moisture in large transformers is sometimes attributed, is the "breathing" of the transformer. When the transformer carries a load and becomes warm, both the oil and the air in the tank expand, and if there is a vent a part of the air will be forced out of the tank. When the load is cut off and the transformer cools, this action is reversed, and a corresponding volume of air is drawn into the tank from the atmosphere. This air carries a certain amount of moisture, which is condensed as the air becomes cooler and forms on the cover and tank wall.

Foreign matter may get into the oil through handling, although oil is usually handled with sufficient care to keep it clean. There is another source of dirt however that cannot be avoided with certain insulating oils used in the past, which throw down a heavy precipitate or sludge when overheated. Modern oils are so prepared that this effect is practically eliminated.

In order to make sure that the dielectric strength is up to its proper value, the insulating oil in any piece of apparatus should be tested at regular intervals. The N. E. L. A. recommends that oil samples from all power station and sub-station apparatus be tested at least once every three months, and that samples from distribution transformers be tested at least once a year.

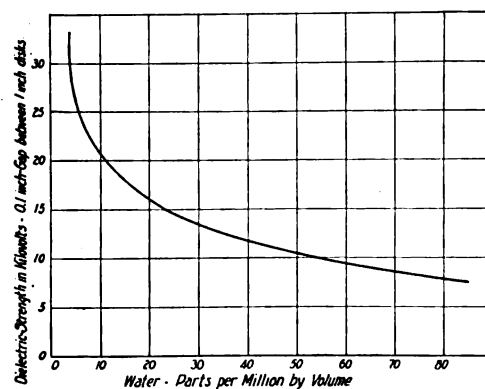
Many users of transformers and large oil circuit breakers do not have the necessary equipment for testing insulating oil. In order that these users may be able to make the periodic tests recommended, the Westinghouse Electric & Manufacturing Company has established an Oil Testing Service.

The Oil Sample Container shown in the illustration has been developed as a part of the Westinghouse Oil Testing Service. This Service furnishes a means by which customers can mail samples of insulating oil to the East Pittsburgh Works for test, and provides:

- A thoroughly dry bottle
- A safe mailing container
- A careful test by experienced engineers
- A prompt report of test results.

The bottles are dried and sealed at our East Pittsburgh Works, and assembled in the parcel post mailing container together with the necessary packing and printed matter.

This service has been developed to make it simple for the customer to handle, and to give him a prompt report as to the condition of the oil.



CURVE SHOWING HOW DIELECTRIC STRENGTH OF INSULATING OIL IS AFFECTED BY MOISTURE

## OIL TESTING SERVICE—Continued

After drawing the oil the customer should reseal and repack the bottle and mail it to the Engineering Laboratory at East Pittsburgh. To simplify these details, an instruction and order sheet and a printed return label have been provided, and are inserted in the carton container. The instructions cover the taking of the sample and its proper preparation for mailing. The label carries an envelope in which the customer should enclose his order covering the work of testing.

NOTE—The containers will not be returned to the customer as the principal item in its cost is the labor involved in so preparing the bottle that it will be in satisfactory condition to receive the sample.

As soon as the test has been made, a report of the condition of the oil is sent by mail directly to the person in the customer's organization who has been designated on the order to receive it. In case the oil is not in first class condition, suggestions as to treatment are given. It is our aim to mail reports within 24 hours from the time samples are received.

	List Price
Carton of six (6) containers, per carton .....	\$ 6 00
Charge for testing service, per sample .....	5 00

## OIL DRUMS

Drums will usually contain 50 gallons of oil but may contain from 49 to 53. The 25-gallon half-drum will also vary at times from 25 to 27 gallons.

**Billing**—When oil is furnished in containers the purchaser will be invoiced the value of such containers, in addition to the billing price of the oil shipped.

**Credit for Drums**—Full credit will be allowed for 25-gallon half-drums and 50-gallon drums when

returned in first-class condition, f.o.b. cars, Rochester, N. Y., Marcus Hook, Pa., or Point Richmond, Cal., provided, however, that invoice or memorandum and necessary shipping papers are promptly forwarded to the Company and return shipment is made within three months from the date of original shipment.

**Shipping Tags** are forwarded with each invoice to facilitate the return of empty drums.

## WEIGHTS OF CONTAINERS

## Approximate Shipping Weights of Cans and Drums Containing Oil

	Lbs.		Lbs.
1-gallon container .....	10	25-gallon drum .....	240
1½-gallon container .....	15	50-gallon drum .....	460
2-gallon container .....	18		
2½-gallon container .....	23	<b>Approximate Weight of Empty Drums</b>	
3-gallon container .....	27	25-gallon drum .....	43
4-gallon container .....	35	50-gallon drum .....	85
5-gallon container .....	45		

## RETURN OF EMPTY DRUMS

When returning empty drums the serial numbers should be itemized on the bill-of-lading and on shipping notices.

Empty drums that were originally forwarded from Point Richmond, Cal., or Pacific Coast Points should be returned to:

The Westinghouse Electric & Mfg. Co.  
Care of Standard Oil Co.,  
Point Richmond, Cal.

freight prepaid. Shipping papers should be made out in duplicate, sending original copy to Westinghouse Electric & Manufacturing Company, San Francisco, Cal., and duplicate copy to The Standard Oil Company, Point Richmond, Cal.

Empty drums that were originally forwarded from points other than Point Richmond, Cal., or Pacific Coast points should be returned to:

The Westinghouse Electric & Mfg. Co.  
Care of The Vacuum Oil Co.,  
Rochester, N. Y.

freight prepaid. Shipping papers should be made out in duplicate, sending original copy to the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and the duplicate copy to the Vacuum Oil Company, Rochester, New York,

Empty drums that were originally forwarded from Marcus Hook, Pa., should be returned to:

The Westinghouse Electric & Mfg. Co.,  
Care of The Sun Oil Co.,  
Marcus Hook, Pa.

freight prepaid. Shipping papers should be made out in duplicate, sending original copy to the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., and the duplicate copy to the Sun Oil Co., Marcus Hook, Pa.



## BABBITTS AND SOLDERS

The babbitt consumer today is confronted with a great variety of babbitts now on the market. In many cases absurd claims are made as to the merits of their product by certain manufacturers. Sometimes such claims are set forth through lack of knowledge on the part of the babbitt manufacturer, and occasionally with the express purpose of inducing the customer to purchase an inferior product at what seems to be a very attractive price.

The Westinghouse Electric & Manufacturing Company has been a manufacturer and one of the largest users of babbitt metals for over thirty years and, in view of the fact that we are both manufacturer and user, we are particularly well qualified to recommend the proper babbitt for any application.

All our alloys are made from **Strictly Virgin Metals** purchased in conformity with the specifications of the American Society of Testing Materials and in accordance with our own formula.

The mixing and alloying of the ingredients is in the hands of experts trained in this line of work, and a very strict laboratory control is exercised over the entire operation. No heat of metal is permitted to enter the manufacturing sections of our shop or our shipping department that does not meet the specifications as to Brinell hardness, and toughness.

We appreciate the important part which babbitt plays in the proper performance of our equipment of every description, and therefore give the making of this material special attention and have perfected the method of manufacture and method of application to a high degree of proficiency during a long period of years of experience.

In addition to this manufacturing experience, our scientific control of our babbitt process guarantees that the best results possible of any specified formula will be obtained.

### PRICES

On account of fluctuations of the metal market, prices on babbitts and solders vary from time to time and will, therefore, be quoted on request.

### BABBITTS

#### WESTINGHOUSE ALLOY No. 25 Lead-Base Babbitt



This is a high grade dependable lead-base babbitt of great uniformity which we have used in our own shops for many years in the manufacture of motors, generators, turbines and other electrical equipment. On account of the frequent requests from our customers for a high grade lead-base babbitt applicable to a large range of operations, we offer this alloy and are prepared to furnish it in any quantity on short notice.

#### WESTINGHOUSE ALLOY No. 14 Genuine Babbitt



This is an extremely high grade tin-base babbitt made according to our own formula which we have used successfully for a large number of years in a

great variety of work where excessive pressures, high speed and heavy duty demand the very best material available. In conformity with the specifications of the American Society of Testing Materials, we guarantee the lead content of this alloy to be not over .35 of one per cent.

This alloy lends itself to a great variety of work, is less sluggish than most genuine babbitt mixtures and can therefore be poured successfully into thin sections requiring a minimum of subsequent machining, or remelting of cuttings.

#### MISCELLANEOUS BABBITTS



We particularly recommend our lead-base babbitt, Westinghouse alloy No. 25 and our tin-base babbitt, Westinghouse alloy No. 14 and can ship these babbitts promptly from stock in reasonable quantities. However, where a customer requires a babbitt made according to his own formula, we can furnish such material when purchased in quantities.

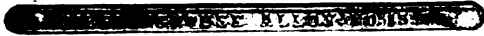
All negotiations on special babbitt alloys should be referred to the Insulation Section, Supply Department

## BABBITS AND SOLDERS—Continued

## SOLDERS

In the manufacture of solders the same high grade materials are used. No antimony is used in any of our solders. While the use of antimony improves the appearance of the solder, we do not consider it good practice, and the performance of the solder is no better when antimony is used in the alloy.

## WESTINGHOUSE ALLOY No. 15



This is what is known to the trade as a strictly half and half solder from which excellent results in a great variety of work have been obtained. The highest grade materials only are used, and this solder is furnished both in the ingot, weighing approximately 8 pounds, and the bar, weighing approximately 1½ pounds.

## WESTINGHOUSE ALLOY No. 19



This is a wiping solder which has given very good results and which is particularly applicable to work where a wiping solder is required. It is furnished in ingots weighing approximately 7½ pounds.

## MISCELLANEOUS SOLDERS



While we particularly recommend our Westinghouse alloy No. 15 for all ordinary soldering purposes and our Westinghouse alloy No. 19 for all purposes where wiping solder will answer, and use these two alloys almost exclusively ourselves, we are prepared to make up special mixtures according to customer's specifications if the alloy be ordered in sufficient quantities.

Such special alloys will be cast into ingots as in the cut shown above and the mixing and alloying will receive careful attention.

## TYPES OF OVERHEAD CONSTRUCTION

At present, overhead line construction is of two distinct types, direct suspension and catenary suspension, each of which two types of construction has its respective field of application. The direct suspension type may be further divided into single bracket arms, double bracket arms, and cross span construction. Catenary construction may be subdivided into bracket arm and bridge, the latter of which varies between greater limits, in regard to both design and cost, than any other form of construction.

Where a new line is projected it is sometimes hard to decide which type should be used inasmuch as there are no set rules for guidance. However, the following will generally hold good:

For city construction with a large number of curves of short radii, switches and crossings, the direct suspension type has advantages.

For use in mines where the space is limited to a few inches between the trolley wire and roof, and where there are also many curves of short radii, the direct suspension type has the advantage.

For industrial railways, operating at low speed, and with a great number of short radius curves, switches and crossings, the direct suspension type has the advantages. In an industrial railway used for transporting material between plants, there might be a long stretch of tangent track where a saving might be effected due to the longer pole spacing which can be used with catenary construction.

For interurban lines, and trunk line electrification, the catenary type of construction has many points of superiority and should be used in the majority of cases. The slight additional cost of messenger cable and hangers is offset by the longer pole spacing which may be used.

Where pantagraph trolley is used, all trolley supports must be kept well above the plane of the trolley wire. At a distance of two feet from the trolley wire and at a distance of six inches above the plane of the trolley wire, the space must be kept clear to prevent interference from the pantagraph contacts due to side sway of car or tilting of the shoe due to the elevation of the outer rail on curves. Direct suspension is not adapted for pantagraph trolley operation unless modifications are made which allow the trolley to hang some distance below the structure both on tangent track and on curves.

The bracket arm type of construction consists of a bracket arm which projects from the pole and from which the trolley wire is suspended. In this type of construction the arm must be of sufficient length so that for interurban service the distance from

center of track to the track side of the pole will not be less than 7 feet, 6 inches. With a standard bracket arm 9 feet long this will allow the trolley to be moved about one foot each way from the normal position due to rake of poles on curves or other causes. Where freight cars are used it is necessary that at least a ten-foot arm be used. This applies to either direct suspension or catenary construction.

The overhead trolley system in mines is dependent on the condition existing in the mine. The spacing varies with the height of the roof; however, a twenty-five foot spacing of hangers is a fair average. The kind of hanger used is also more or less dependent on the height of roof. If the roof is low, hangers are close together so that the pressure of the trolley cannot press the trolley wire against the roof. If the roof is timbered the lag screw and ordinary mine suspension is the proper type to use.

As city systems in many cases are of cross-span construction it is essential that the trolley wire be kept as small as practicable in order that the strain on the poles may be reduced to a minimum.

For city service, it appears that 00 round wire meets the requirements to the best advantage.

For interurban service, where the trolley wire carries a heavy current, frequently without feeder, a 0000 trolley wire is required and where high speeds require a very rugged line construction with smooth underrun a 0000 trolley wire of standard grooved section is best adapted.

In coal mines and mines of other character it is also necessary that the overhead construction be strong mechanically and carry heavy currents without excessive drop in voltage. The line material must be exceptionally well constructed because of the severity of conditions to which it is subjected. Besides severe mechanical strains, there are to be withstood the corrosive action of mine waters and the constant fall of slate, which is so great as to necessitate frequent replacement of timbers, suspensions and clamps.

For this purpose also 0000 grooved wire is well adapted as the section enables the wire to be securely held by means of trolley ears, and adapts itself very easily to approved forms of overhead frogs, crossings and splicers.

Practically none of the recent developments use figure 8 wire and the practice is discouraged by most engineers.

We include in the pages following an approximate list of the materials necessary to construct one thousand feet of overhead in a mine, and one mile of the different types of construction used by street and interurban railway companies.

## CROSS SPAN CONSTRUCTION

The material necessary for one mile of tangent track, 600 volts, 100 foot pole spacing, direct suspension is as follows:

- 106 Poles, either steel or wood.
- 48 Cross-span cables,  $\frac{3}{8}$ -inch Siemens Martin double galvanized strand.
- 5 Feed-in-spans as per Fig. 1.
- 106 Eye bolts,  $\frac{3}{8}$  x 12 inches for wood poles.

- 106 Pole bands for steel poles.
- 106 Wood strain insulators for steel poles.
- 48 Straight line suspensions.
- 5 Feeder suspensions.
- 51 Straight line ears.
- 2 Strain ears.
- 2 Strain plates.
- 24 Wood strain insulators.

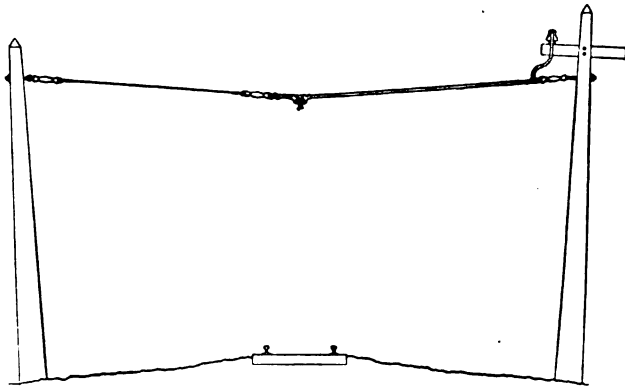


FIG. 1—CROSS SPAN CONSTRUCTION

- 8 Guy anchors.
- 8 Strain insulators.
- 24 Three bolt guy clamps.
- 16 Pole shims.
- 16 One bolt guy hooks.
- 16  $\frac{1}{2}$  x 4-inch lag screws.
- 5300 Feet trolley wire.
- 700 feet  $\frac{3}{8}$ -inch Siemens Martin double galvanized cable for anchors and guys.
- 5 Lightning arresters.
- 2 Trolley wire splicers.
- 352 12-inch flexible rail bonds.
- 5 6-foot solid cross bonds.

## BRACKET ARM CONSTRUCTION

The material necessary for one mile of tangent track, 600 volts, 100 foot pole spacing, direct suspension bracket arm construction is as follows:

- 53 Poles, either steel or wood.
- 106 Wood strain insulators for iron poles.
- 53 Bracket arms.
- 53 Straight line suspensions.
- 46 Straight line ears.
- 5 Feeder ears.
- 2 Strain ears.
- 2 Strain plates.
- 4 Guy anchors.
- 8 Strain insulators.
- 12 Three bolt guy clamps.
- 8 One bolt guy hooks.
- 8 Pole shims.
- 130 lag screws,  $\frac{1}{2}$  x 3 inches.
- 5300 Feet trolley wire.
- 540 Feet Siemens Martin double galvanized cable for anchors and guys.
- 5 Lightning arresters.
- 2 Trolley wire splicers.
- 352 12-inch flexible rail bonds.
- 5 6-foot solid cross bonds.

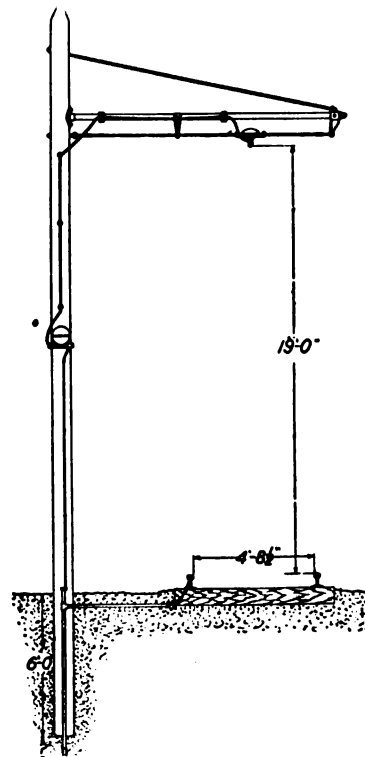


FIG. 2—BRACKET ARM DIRECT SUSPENSION

## MINE CONSTRUCTION

The material necessary for 1000 feet of tangent track is as follows:

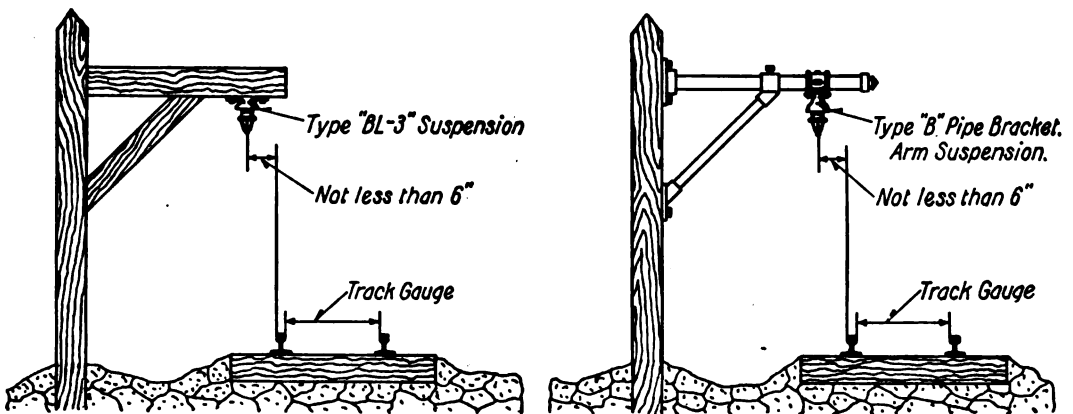
- 1000 Feet trolley wire (4/0 grooved preferable).
- 50 Mine suspensions.
- 50 Expansion bolts.
- 50 Mechanical clamps.
- 1 Trolley splicer.
- 67 Rail bonds.
- 1 Cross bond, 6 feet long.

Spacing of mine suspensions on curves:

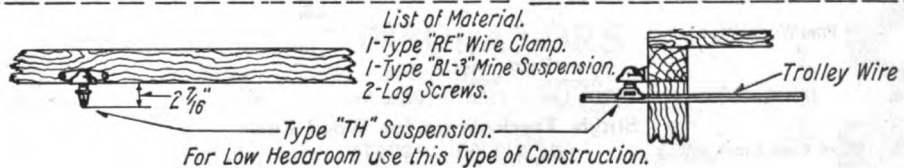
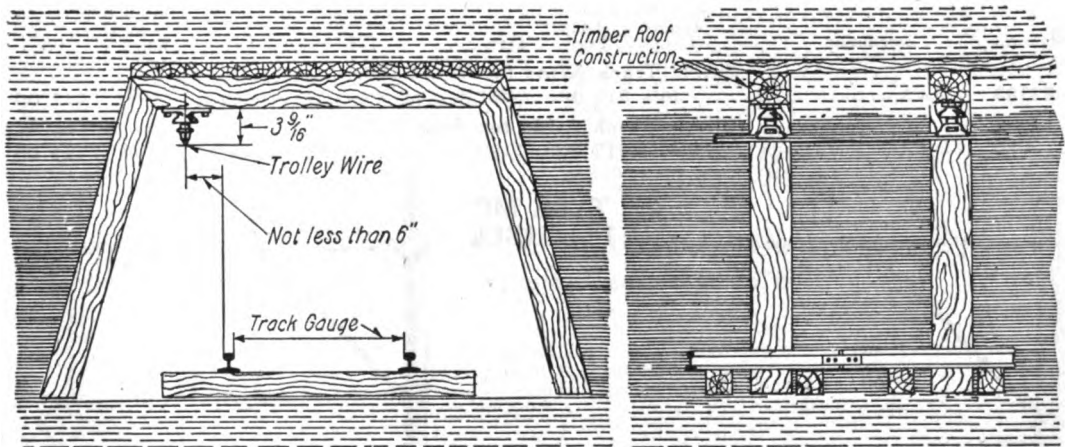
- Tangent to 120 feet radius..... 20 feet
- 120-Foot radius to 90-foot radius..... 15 feet
- 90-Foot radius to 60-foot radius..... 10 feet
- 60-Foot radius to 40-foot radius..... 6½ feet
- 40-Foot radius to 20-foot radius..... 5 feet

In new mines 30-foot rails are used, but in old ones a 20-foot rail is common and 100 bonds per 1000 feet are required.

### Outside Construction

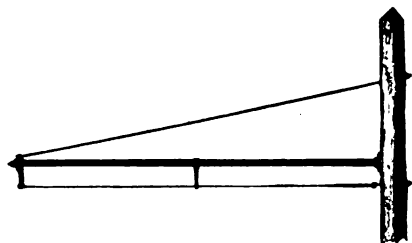


### Timber Roof Construction



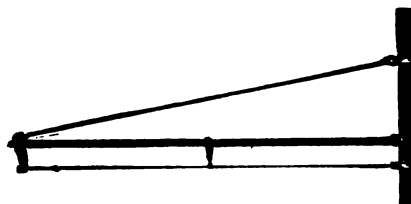
# STANDARD BRACKET ARMS

With Type C Tubing



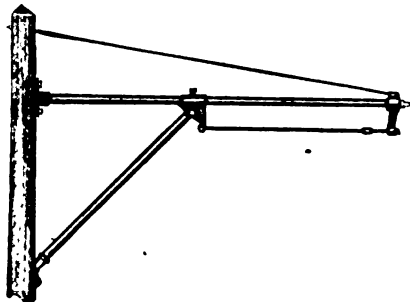
FOR WOOD POLE

**TYPE LC  
FLEXIBLE**



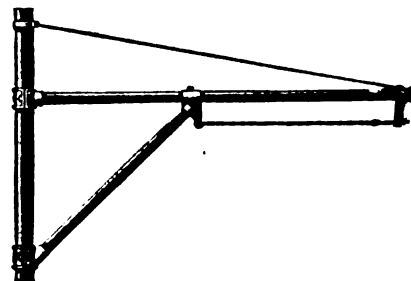
FOR 5-INCH STEEL POLE

Style No.	Description	EACH		Style No.	Description	EACH	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
<b>Single Track Arms for Wood Poles</b>							
81599	9-foot Arm, 2-inch tubing	52	\$ 9 00	81600	9-foot Arm, 1½-inch tubing	40	\$7 30
139100	10-foot Arm, 2-inch tubing	57½	10 00	139102	10-foot Arm, 1½-inch tubing	44	8 00
139101	12-foot Arm, 2-inch tubing	68	12 00	139103	12-foot Arm, 1½-inch tubing	48½	9 40
<b>Single Track Arms for Steel Poles</b>							
118987	9-foot Arm, 2-inch tubing	56½	\$13 80	118990	9-foot Arm, 1½-inch tubing	44	10 90
<b>Double Track Arms for Steel Poles</b>							
118996	9-foot Arm, 2-inch tubing	109	\$22 20	118999	9-foot Arm, 1½-inch tubing	85	17 10



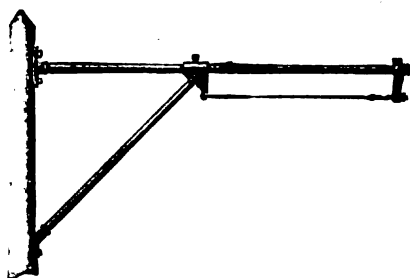
FOR WOOD POLE

**TYPE LMC  
FLEXIBLE**



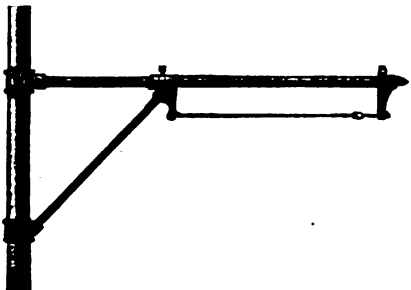
FOR STEEL POLE

Style No.	Description	EACH		Style No.	Description	EACH	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
<b>Single Track Arms for Wood Poles</b>							
92133	9-foot Arm, 2-inch tubing	70½	\$13 00	92132	9-foot Arm, 1½-inch tubing	55	\$11 00
<b>Single Track Arms for Steel Poles</b>							
119020	9-foot Arm, 2-inch tubing	80½	\$17 00	119017	9-foot Arm, 1½-inch tubing	65	15 00



FOR WOOD POLE

**TYPE MC  
FLEXIBLE**



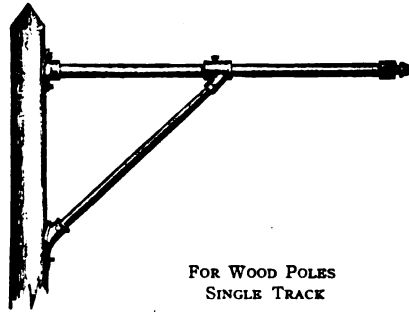
FOR STEEL POLE

Style No.	Description	EACH		Style No.	Description	EACH	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
<b>Single Track Arms for Wood Poles</b>							
97474	9-foot Arm, 2-inch tubing	63½	\$11 50	97475	9-foot Arm, 1½-inch tubing	51	\$9 50
<b>Single Track Arms for Steel Poles</b>							
118948	9-foot Arm, 2-inch tubing	72½	\$15 50	118951	9-foot Arm, 1½-inch tubing	59	13 50

Order by Style Number

STANDARD BRACKET ARMS—Continued

TYPE MC NON-FLEXIBLE



FOR WOOD POLES  
SINGLE TRACK

Style No.	Description	EACH		Style No.	Description	EACH	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
<b>With Type C Tubing</b>				<b>With Type A Tubing</b>			
97466	9-foot Arm, 2-inch tubing	60	\$8 50	268340	9-foot Arm, 2-inch tubing	47	\$8 20
97467	9-foot Arm, 1½-inch tubing	47	7 15	268341	9-foot Arm, 1½-inch tubing	38	6 85
268342	6-foot Arm, 1½-inch tubing	30	5 00	268343	6-foot Arm, 1½-inch tubing	22	4 70
268344	4-foot Arm, 1½-inch tubing	25	4 50	268345	4-foot Arm, 1½-inch tubing	18	4 30

Bracket Arm Parts

Type C Tubing			
Style No.	Description	Approx. Wt., Lbs.	List Price
100416	Arm, 9 feet of 2-inch tubing	32½	.....
142021	Arm, 10 feet of 2-inch tubing	36½	.....
142022	Arm, 12 feet of 2-inch tubing	45	.....
100418	Brace, 6 feet of 1½-inch tubing	16	.....

Tension Rods

Style No.	Description	Approx. Wt., Lbs.	List Price
87664	½-inch Rod, 10 feet, 2 inches long	7	\$1 70
139104	½-inch Rod, 11 feet, 3½ inches long	8	1 90
139105	½-inch Rod, 13 feet, 6 inches long	9½	2 30
81798	½-inch Rod, 9 feet, 6½ inches long	6½	1 70

Castings, Sherardized

Style No.	Description	Approx. Wt., Lbs.	List Price
81607	End casting, 2-inch, for type LC for wood poles	3	\$1 30
83355	End casting, 2-inch, for type LC for steel poles	3	1 30
83347	End casting, 2-inch, for type MC	2	70
100420	Socket only, curved, 2-inch	2	80
248397	Socket only, flat, 2-in. for wood pole	2	80
120076	Socket only, 2-inch for 5-inch steel pole, single track	5	3 15
120082	Socket only, 2-inch for 5-inch steel pole, double track	6	3 50
100422	Lower socket, 2-inch for wood pole	2½	1 10
119043	Lower socket, 2-inch for 5-inch steel pole	8½	3 50
263383	Middle support, 2-inch, type LC	2½	70
100426	Middle support, 2-inch, type LMC	3½	2 20
100424	Middle support, 2-inch, type MC	3½	1 75
101954	Eye bolts, ½-inch by 12 inches	1	.....
118984	Band only for 5-inch steel pole, single track	2	.....
119014	Band only for 5-inch steel pole, double track	2½	.....
81608	End casting, 1½-inch, for type LC for wood poles	3	\$1 10
83356	End casting, 1½-inch, for types LMC and MC for steel poles	2½	1 10
83348	End casting, 1½-inch, for type MC for wood poles	2	60
100421	Socket only, curved, 1½-inch for wood pole	2	60
120079	Socket only, 1½-inch for 5-inch steel pole, single track	5	3 15
120085	Socket only, 1½-inch for 5-inch steel poles, double track	6	3 50
100423	Lower socket, 1½-in. for wood pole	2½	1 10
119046	Lower socket, 1½-inch for steel poles	7½	3 50
263384	Middle support, 1½-inch, type LC	2	60
100427	Middle support, 1½-inch, type LMC	4	1 80
100425	Middle support, 1½-inch, type MC for wood pole	3½	1 50
83393	Eye bolts, ½-inch by 5 inches	½	.....



INSULATED MIDDLE SUPPORTS

Sherardized—750 Volts

Style No.	Description	PER 100	
		Approx. Wt., Lbs.	List Price
136104	Support for 1½-inch tube complete with spool	350	\$125 00
136105	Support for 2-inch tube complete with spool	360	180 00
119081	Split porcelain spool	28	6 00

FEEDER TAP INSULATORS

Sherardized—750 Volts

Style No.	Description	PER 100	
		Approx. Wt., Lbs.	List Price
119079	Complete for 1½-inch tube	170	\$80 00
119080	Complete for 2-inch tube	180	90 00
119081	Split porcelain spool	28	6 00

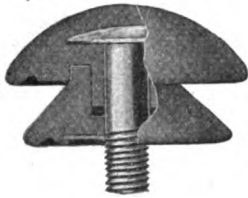


Order by Style Number

## CAP AND CONE INSULATORS

750 Volts—Test Voltage 10,000

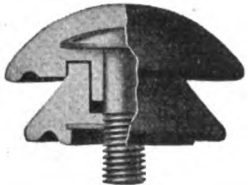
### TYPE A CAP AND CONE



TYPE A

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
185775	Standard Cap and cone insulator	100	\$84 00
185772	Standard Cap only	70	56 00
185773	Standard Cone only	30	28 00

### TYPE A-1, FOR USE WITH LOCK WASHERS



TYPE A-1

241640	Hot Mould special cap and cone insulator	95	\$84 00
241672	Hot Mould standard cap only	70	56 00
241639	Hot Mould special cone only	25	28 00

### COKE OVEN TYPE

268527	Complete cap and cone with extension stud, lock washer and nut	140	\$130 00
290719	Cap and cone only	108	84 00
265956	Standard cap only	70	56 00
285631	Special cone only	38	28 00
278006	Extension stud only with lock washer and nut	32	46 00

### TYPE A TONGS



COKE OVEN TYPE

Style No.	Description	EACH	
		Wt., Lbs.	List Price
357204	Type A tongs	3	\$2 50

Order Cap and Cone Tongs, Style No. 119357, for use with ceiling suspensions.

## TYPE A SUSPENSIONS

750 Volts



SINGLE CURVE



STRAIGHT LINE



DOUBLE CURVE

### SINGLE TROLLEY



SINGLE CURVE

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
52557	Straight line complete	195	\$132 00
52559	Straight line, malleable iron body only, sherardized	102	48 00
52560	Single curve complete	222	140 00
52562	Single curve, malleable iron body only, sherardized	129	56 00
52563	Double curve complete	286	168 00
52565	Double curve, malleable iron body only, sherardized	193	84 00

### DOUBLE TROLLEY



STRAIGHT LINE



DOUBLE CURVE

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
82645	Straight line complete	436	\$268 00
82648	Straight line, malleable iron body only, sherardized	250	100 00
82633	Single curve complete	461	293 00
82636	Single curve, malleable iron body only, sherardized	275	125 00
82639	Double curve complete	486	308 00
82642	Double curve, malleable iron body only, sherardized	300	140 00

Order by Style Number



TYPE A SUSPENSIONS—Continued

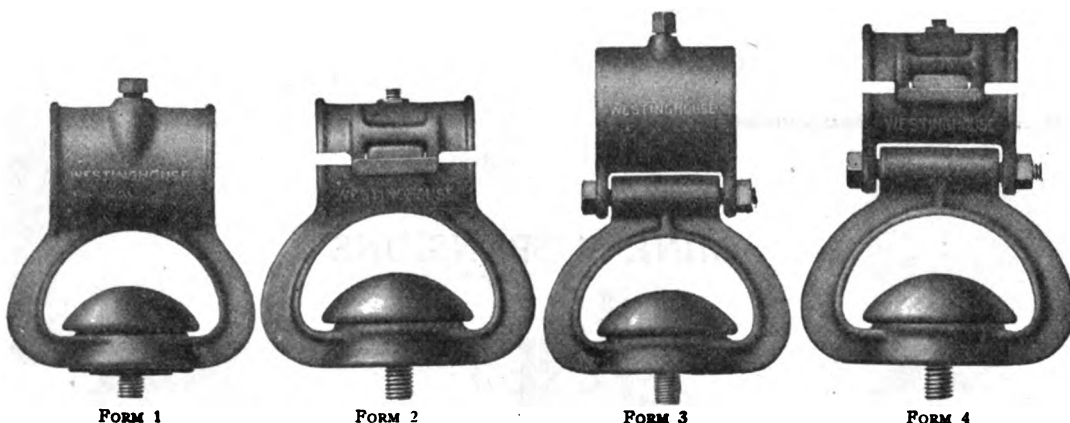
CEILING, MINE AND STRAIN



Style No.	Description	Diameter Stud, Inches	PER 100	
			Wt., Lbs.	List Price
52566	Complete	3/4	245	\$154 00
52568	Malleable iron body sherardized	3/4	152	70 00
52569	Complete	3/4	360	184 00
52571	Malleable iron body sherardized	3/4	270	100 00
52572	Complete	3/4	425	209 00
52574	Malleable iron body sherardized	..	330	125 00

\*1/4-inch by 2-inch lag screws or 1/2-inch bolts are suitable for the ceiling suspensions.

BRACKET



Style No.	Description	Size Pipe, Inches	Diameter Stud, Inches	PER 100	
				Wt., Lbs.	List Price
<b>Pipe Bracket—Form 1—Rigid With Sleeve Clamp</b>					
182006	Complete	1 1/2	3/4	433	\$234 00
144047	Body sherardized	1 1/2	3/4	340	150 00
182007	Complete	2	3/4	473	250 00
144048	Body sherardized	2	3/4	380	166 00
<b>Pipe Bracket—Form 2—Hinged With Sleeve Clamp</b>					
52576	Complete	1 1/2	3/4	488	250 00
52582	Body sherardized	1 1/2	3/4	395	166 00
52578	Complete	2	3/4	527	262 00
52583	Body sherardized	2	3/4	434	178 00
<b>Pipe Bracket—Form 3—Rigid With Split Clamp</b>					
182005	Complete	1 1/2	3/4	393	234 00
167507	Body sherardized	1 1/2	3/4	300	150 00
<b>Pipe Bracket—Form 4—Hinged With Split Clamp</b>					
171086	Complete	1 1/2	3/4	317	250 00
186868	Body sherardized	1 1/2	3/4	224	166 00
171088	Complete	2	3/4	353	262 00
186867	Body sherardized	2	3/4	260	178 00

Order by Style Number

## TYPE B SUSPENSIONS

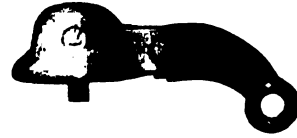
750 Volts—Round Top



STYLE NOS. 227032 AND 227037



STYLE NO. 227146



STYLE NO. 227144

Style No.	Description	Diam. Body, Inches	Diam. Stud, Inches	PER 100	
				Wt., Lbs.	List Price
227032	Straight line, medium size	3 1/4	5/8	175	\$105 00
227037	Straight line, large size	3 1/2	5/8	200	120 00
227140	Straight line without arms	3 1/4	5/8	185	115 00
227142	Single curve without arm	3 1/4	5/8	160	110 00
227144	Single curve with arm	3 1/4	5/8	230	140 00
227146	Double curve with arms	3 1/4	5/8	325	175 00
227148	Arm only	...	...	55	30 00



### TYPE B-1 SUSPENSION

Style No.	Description	Diam. Body, Inches	Diam. Stud, Inches	PER 100	
				Wt., Lbs.	List Price
300814	Straight line, medium size	3 1/4	5/8	210	\$108 00
305688	Straight line, large size	3 1/2	5/8	235	123 00

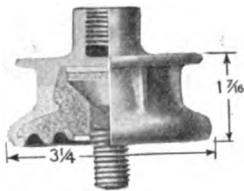
### CROSS-SPAN HANGER TOOL



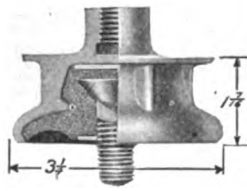
Style No.  
128426

EACH		List Price
Approx. Net Wt., Lbs.		
4 1/2		\$7 50

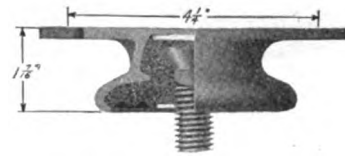
## MINE SUSPENSIONS



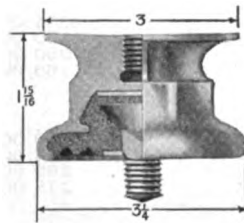
TYPE BF SUSPENSION



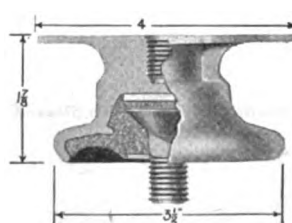
TYPE BF-2 SUSPENSION



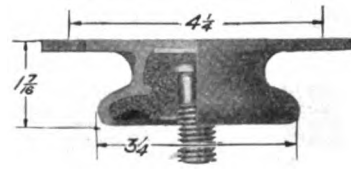
TYPE BL-3 SUSPENSION



TYPE LH SUSPENSION



TYPE LJ COMBINATION SUSPENSION

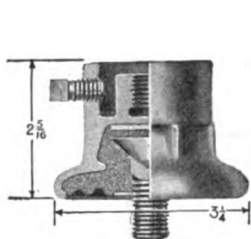


TYPE BL-5 SUSPENSION

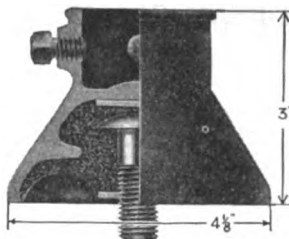
Style No.	Description	Type	Diam Body, Inches	PER 100	
				Wt., Lbs.	List Price
207352	Rock suspension sherardized	BF	3 1/4	150	\$90 00
207353	Timber suspension sherardized	BL-3	3 1/4	140	90 00
227139	Timber suspension sherardized	BL-3	3 1/4	165	95 00
246700	Rock suspension japanned	BF-2	3 1/4	150	90 00
252115	Timber suspension japanned	BL-5	3 1/4	140	90 00
246702	Combination suspension sherardized	LH	3 1/4	160	95 00
246701	Combination suspension japanned	LH	3 1/4	160	95 00
294317	Combination suspension sherardized	LJ	3 1/2	175	110 00
294318	Combination suspension japanned	LJ	3 1/2	175	110 00

Order by Style Number

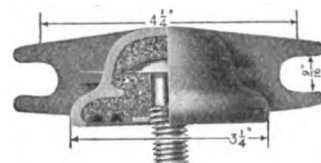
MINE SUSPENSIONS—Continued



(PATENTED)  
TYPE JW SUSPENSION



TYPE AM-1 SUSPENSION



TYPE TH SUSPENSIONS

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
246703	Type JW Suspension, japanned	170	\$117 60
246704	Type JW Suspension, sherardized	170	121 80
296305	Type AM-1 Suspension for 1 1/4-inch pipe	262	120 00
246708	Type TH Suspension, sherardized	155	115 00
247851	Type TH Suspension, japanned	155	115 00

TYPE BF WRENCH

Style No.	Description	EACH	
		Approx. Net Wt., Lbs.	List Price
112740	For BF, LH & JW Suspensions and RE Clamps	1 1/4	\$0 50
281996	For BF, LH & JW Suspensions and RE-1 Clamps	1 1/4	50



TYPE B PIPE BRACKET SUSPENSIONS



FORM 2

Style No.	Description	Size Pipe, Inches	Diam. Stud, Inches	PER 100	
				Wt., Lbs.	List Price
<b>Form 2—Hinged With Split Clamp</b>					
52596	Sherardized	1 1/2	3/4	360	\$225 00
52598	Sherardized	2	3/4	400	250 00
<b>Form 4—Hinged With Split Clamp</b>					
182360	Sherardized	1 1/2	3/4	355	225 00
182354	Sherardized	2	3/4	395	250 00
<b>Insulated Bell for Pipe Bracket Suspensions</b>					
227138	Sherardized		3/4	150	115 00



FORM 4

PIPE ADAPTER FOR TYPES LH AND LJ COMBINATION MINE SUSPENSIONS



WASHER  
STYLE No. 225318



STYLE No. 146065



STYLE NOS. 294319 AND 294320



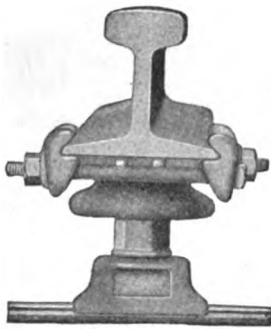
STYLE No. 146066

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
146065	For 1 1/4-inch vertical pipe, malleable iron sherardized	137	\$72 00
146066	For 1 1/2-inch horizontal pipe, malleable iron sherardized	180	75 00
294319	For 1 1/4-inch vertical pipe, malleable iron sherardized	70	72 00
294320	For 1 1/4-inch vertical pipe, malleable iron japanned	70	72 00
225318	Washer, malleable iron, sherardized, for use with BF and BF-2 suspensions to eliminate the boss	50	28 00

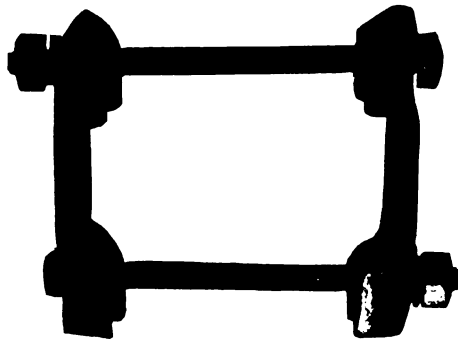
Order by Style Number

MINE SUSPENSIONS—Continued

I-BEAM CLAMP



APPLICATION



STYLE NUMBER 287555

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
287555	Clamp complete, sherardized	121	\$50 00
287554	Clamp only, sherardized	40	21 50

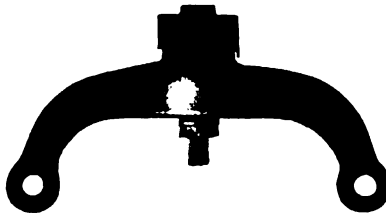
TYPE C SUSPENSIONS

For Voltages Up to 750—Test Voltage 10,000 Volts

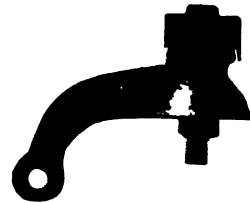
SINGLE TROLLEY



STRAIGHT LINE—STYLE No. 52602



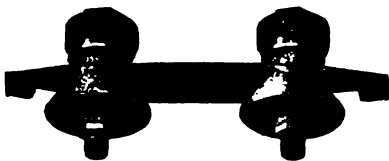
DOUBLE CURVE—STYLE No. 54928



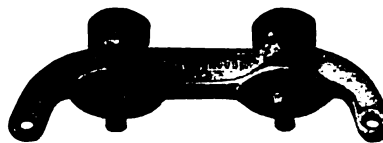
SINGLE CURVE—STYLE No. 54966

Style No.	Description	Diam. Stud. Inches	PER 100	
			Wt., Lbs.	List Price
52602	Straight line complete	3/8	264	\$148 00
52604	Straight line malleable iron body and cap, sherardized	3/8	196	92 00
52928	Double curve complete	3/8	345	172 00
52930	Double curve malleable iron body and cap, sherardized	3/8	277	116 00
54966	Single curve complete	3/8	262	156 00
54924	Single curve malleable iron body and cap, sherardized	3/8	194	100 00

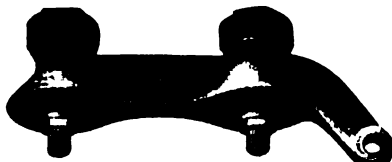
DOUBLE TROLLEY



STRAIGHT LINE STYLE No. 82655



DOUBLE CURVE STYLE No. 82667



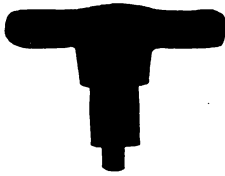
SINGLE CURVE STYLE No. 82661

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
82655	Straight line complete	572	\$397 00
82661	Single curve complete	600	472 00
82667	Double curve complete	610	512 00
82773	Straight line body only, sherardized	436	285 00
82776	Single curve body only, sherardized	464	360 00
82779	Double curve body only, sherardized	474	400 00

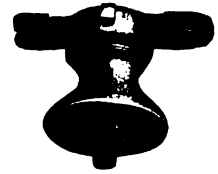
Order by Style Number

TYPE C SUSPENSIONS—Continued

CEILING SUSPENSIONS



FORM 1



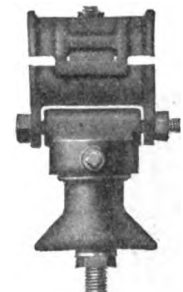
FORM 2

Style No.	Description	Diam. In.	Stud Wt. Lbs.	PER 100 List Price
54934	Ceiling, Form 1 complete	5/8	216	\$98 00
54936	Ceiling, Form 1 body sherardized	..	148	42 00
82742	Ceiling, Form 2 complete	5/8	258	166 00
82747	Ceiling, Form 2 body sherardized	..	190	110 00

PIPE BRACKET SUSPENSIONS



FORM 2



FORM 4

Style No.	Description	Size Pipe In.	Dia. Stud In.	Wt. Lbs.	PER 100 List Price
<b>Form 2—Hinged With Sleeve Clamp</b>					
54937	Complete	1 1/2	5/8	458	\$276 00
54943	Malleable iron body sherardized	1 1/2	..	390	220 00
54939	Complete	2	5/8	488	301 00
54944	Malleable iron body sherardized	2	..	420	245 00
<b>Form 4—Hinged With Split Clamp</b>					
182041	Complete	1 1/2	5/8	458	276 00
182039	Malleable iron body sherardized	1 1/2	..	390	220 00
182045	Complete	2	5/8	488	301 00
182037	Malleable iron body sherardized	2	..	420	245 00

The distance from the bottom of the bracket tubing to the shoulder of the bolt is 5 inches.

INSULATED BOLTS

For Use With Type C Suspensions



STYLE No. 229814

Style No.	Description	Diam. Inches	Stud Inches	PER 100 Wt. Lbs.	List Price
229814	Standard insulated bolt, 750 volt	5/8	..	70	\$56 00
88703	Special insulated bolt, 750 volt	5/8	..	55	80 00

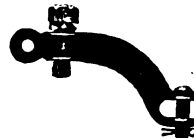
TYPE D SUSPENSIONS



STRAIGHT LINE  
STYLE No. 127059



STRAIGHT LINE  
STYLE No. 82701



SINGLE CURVE  
STYLE No. 54950

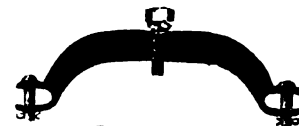


DOUBLE TROLLEY YOKE  
STYLE No. 82689

Style No.	Description	Diam. Inches	Stud Inches	PER 100 Wt. Lbs.	List Price
<b>Suspensions for Single Trolley</b>					
127059	Straight line suspension	5/8	..	225	\$110 00
54950	Single curve suspension	5/8	..	169	90 00
54956	Double curve suspension	5/8	..	245	145 00
<b>Suspensions for Double Trolley</b>					
Six-inch spacing between stud centers					
82701	Straight line suspension	5/8	..	410	215 00
82629	Single curve suspension	5/8	..	360	185 00
82617	Double curve suspension	5/8	..	420	270 00
<b>Straight Line Yoke for Double Trolley</b>					
Six-inch spacing between stud centers					
82689	Complete, 5/8-inch bolt	5/8	..	262	140 00



SINGLE CURVE  
STYLE No. 82629



DOUBLE CURVE  
STYLE No. 54956



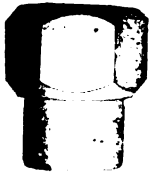
DOUBLE CURVE  
STYLE No. 82617

Wood Strain Insulators, Duro Strain Insulators and Globe Strain Insulators for Use with These Suspensions are Listed in Catalogue Section 6-C.

Order by Style Number

**PIPE EXTENSION COUPLINGS**

For Use with 3/4-inch Pipe

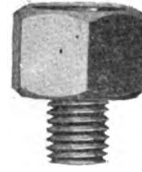


STYLE No. 289975

Style No. 289975  
289976

Description  
Upper pipe extension coupling, sherardized  
Lower pipe extension coupling, sherardized

PER 100	
Wt., Lbs.	List Price
27	\$50 00
22	40 00



STYLE No. 289976

**EXPANSION BOLTS**

Sherardized



FORM A-M



FORM B-M



FORM C-M



FORM W-S

**Form AM** has a 5/8-inch bolt with hexagon head; for use with type A mine suspension.

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
125763	Complete with 4-inch shell	113	\$48 00
141620	Complete with 6-inch shell	159	61 00

**Form BM** has a 5/8-inch stud with fixed hexagon shoulder.

127267	Complete with 4-inch shell	120	62 50
141621	Complete with 6-inch shell	170	75 00

**Form CM** has a 5/8-inch stud, threaded at both ends.

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
109142	Complete with 4-inch shell	120	\$42 00
141622	Complete with 6-inch shell	170	55 00

**Form WS** consists of wood plug 1 1/2-inch by 3 or 4-inch and stud lag 5/8-inch by 4 or 5 inches.

83123	4-inch wood plug	16	8 00
256266	3/4x5-inch stud lag, sherardized	27	11 00
306281	3-inch wood plug	14	6 00
306283	3/4x4-inch stud lag, sherardized	22	9 00

**FEED WIRE INSULATORS FOR MINES**



TYPE MF



TYPE MG



TYPE RS

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
<b>Type MF</b>			
246707	Complete with sherardized pin	106	\$26 00
251643	Complete with plain pin	106	26 00
246705	Porcelain spool	60	9 00
246706	Malleable iron pin, plain	46	17 00
256261	Malleable iron pin, sherardized	46	17 00
<b>Type MG</b>			
182018	Complete with sherardized pin	200	44 00
256262	Complete with plain pin	200	44 00
146632	Porcelain spool	120	16 00
137728	Malleable iron pin, sherardized	80	28 00
256306	Malleable iron pin, plain	80	28 00
356831	Complete with sherardized pin, and 1-inch grooved porcelain spool	210	44 00
356830	Porcelain spool only, 1-inch groove	130	16 00
<b>Type RS</b>			
300641	Complete	118	27 80
246705	Porcelain Spool	56	9 00
304421	Malleable Iron Pin	50	17 00
304422	Malleable Iron Washer	12	1 80

FEED WIRE INSULATORS FOR MINES—Continued

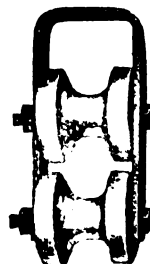
FEED WIRE INSULATORS FOR HEAVY CABLE



TYPE OS  
STYLE No. 251712

Style No.	Description
251712	500,000 CM Insulator, Single Spool
251713	1,000,000 CM Insulator, Single Spool
300854	500,000 CM Insulator, Double Spool
304423	1,000,000 CM Insulator, Double Spool
288089	500,000 CM Spool Only
288088	1,000,000 CM Spool Only

PER 100	
Wt., Lbs.	List Price
170	\$ 36 50
372	79 00
355	100 00
727	190 00
100	20 00
238	62 50



TYPE DS  
STYLE No. 304423

FEEDER SUSPENSIONS



SYRACUSE TYPE



CONNECTICUT TYPE



PITTSBURGH TYPE

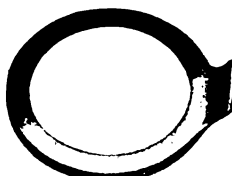
Style No.	Description	Diameter Stud Inches	PER 100	
			Wt., Lbs.	List Price
†121602	Syracuse	3/4	85	\$ 90 00
47893	Connecticut	3/4	150	144 00
216193	Pittsburgh	3/4	100	90 00
*245985	Utica	3/4	90	90 00

†The Syracuse type is also made with malleable iron yoke for use as a non-insulated suspension.  
\*The Utica type is similar to the Syracuse type except heavier in design.

ARMORED FEEDER INSULATORS



CORNER INSULATOR  
WITHOUT COLLAR  
STYLE No. 275607



COLLAR  
STYLE No.  
275609



CORNER INSULATOR  
WITH COLLAR  
STYLE No. 226332

STRAIGHT LINE

Style No.	For Feeders, C.M.	PER 100	
		Wt., Lbs.	List Price
216151	500,000	170	\$120 00
268588	1,000,000	200	130 00

CORNER

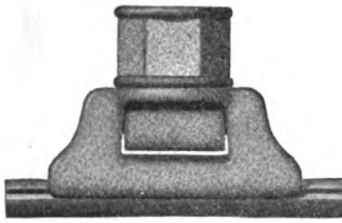
Style No.	For Feeders, C.M.	Wt., Lbs.	List Price
With Collar			
226332	500,000	235	160 00
256182	1,000,000	335	195 00
Without Collar			
275607	500,000	195	140 00
275608	1,000,000	285	170 00
Collar Only			
275609	500,000	40	20 00
275610	1,000,000	50	25 00



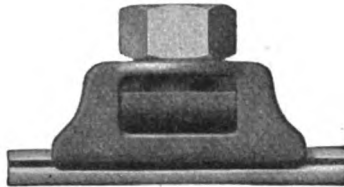
STRAIGHT LINE  
INSULATOR  
STYLE No. 216151

Order by Style Number

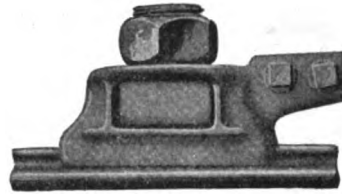
MINE CLAMPS



**TYPE RE**  
MALLEABLE IRON—  
LENGTH 3 INCHES



**TYPE RE-1**  
MALLEABLE IRON—  
LENGTH 3 INCHES



**TYPE RE-1**  
MECHANICAL FEEDER CLAMP  
BRONZE—LENGTH 3 INCHES

Style No.	Size Wire	Diam. Tap. Inches	PER 100	
			Wt., Lbs.	List Price

**TYPE RE CLAMP**

180417	No. 00-0000 grooved	5/8	65	\$66 00
180418	No. 00-0000 Fig. 8	5/8	65	68 00
220287	No. 00 round	5/8	65	68 00
221308	No. 000-0000 round	5/8	65	68 00
239225	No. 0 round—bronze jaws	5/8	65	100 00

**TYPE RE-1 CLAMP**

279361	No. 00-0000 grooved	5/8	65	51 00
280229	No. 00-0000 Fig. 8	5/8	65	51 00

**TYPE RE-1 MECHANICAL FEEDER CLAMP**

Style No.	Description	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
285471	No. 00-0000 grooved wire	5/8	81	\$110 00
285472	No. 00-0000 Fig. 8 wire	5/8	81	110 00



**WEDGE TYPE**  
MALLEABLE IRON, SHERARDIZED—LENGTH 4 INCHES

**WEDGE TYPE CLAMP**

Style No.	Description	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
289070	No. 00-0000 grooved wire	5/8	100	\$60 00
291611	No. 00-0000 Fig. 8 wire	5/8	100	60 00
292337	No. 00 round wire	5/8	100	60 00
292338	No. 000-0000 round wire	5/8	100	60 00

**UNIVERSAL WRENCH FOR MINE CLAMPS**



Style No	Description	EACH	
		Weight, Lbs.	List Price
296497	Malleable Iron, Sherardized	1	\$0 50

Order by Style Number

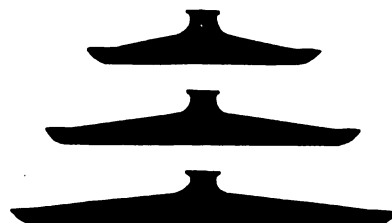


## TROLLEY EARS

## BRONZE

## TYPE E FOR ROUND WIRE

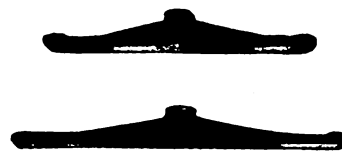
Style No.	Size Wire	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
<b>Length, 9 inches</b>				
318643	No. 0 round	$\frac{5}{16}$	65	\$ 76 00
318644	No. 00 round	$\frac{3}{8}$	65	82 00
<b>Length, 12 inches</b>				
318645	No. 0 round	$\frac{5}{16}$	85	88 00
318646	No. 00 round	$\frac{3}{8}$	85	96 00
318647	No. 000 round	$\frac{7}{16}$	110	104 00
318649	No. 0000 round	$\frac{1}{2}$	110	112 00
<b>Length, 15 inches</b>				
318651	No. 0 round	$\frac{5}{16}$	100	102 00
318652	No. 00 round	$\frac{3}{8}$	105	110 00
318653	No. 000 round	$\frac{7}{16}$	130	120 00
318655	No. 0000 round	$\frac{1}{2}$	135	130 00



TYPE E

## TYPE EL LOW-CENTER EAR FOR ROUND WIRE

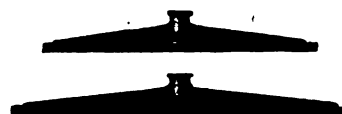
Style No.	Size Trolley Wire	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
<b>Length 12 Inches</b>				
318631	No. 0 round	$\frac{5}{16}$	88	\$ 88 00
318632	No. 00 round	$\frac{3}{8}$	85	96 00
318633	No. 000 round	$\frac{7}{16}$	105	104 00
318635	No. 0000 round	$\frac{1}{2}$	110	112 00
<b>Length 15 Inches</b>				
318637	No. 0 round	$\frac{5}{16}$	100	102 00
318638	No. 00 round	$\frac{3}{8}$	105	110 00
318639	No. 000 round	$\frac{7}{16}$	125	120 00
318641	No. 0000 round	$\frac{1}{2}$	130	130 00



TYPE EL

## TYPE G FOR GROOVED AND FIG. 8 WIRE

Style No.	Size Wire	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
<b>Length, 12 Inches</b>				
122611	No. 0 grooved	$\frac{5}{16}$	80	\$105 00
82799	No. 00 grooved	$\frac{3}{8}$	85	115 00
122609	No. 000 grooved	$\frac{7}{16}$	95	125 00
82801	No. 0000 grooved	$\frac{1}{2}$	100	135 00
<b>Length, 15 Inches</b>				
124760	No. 0 grooved	$\frac{5}{16}$	100	122 00
82803	No. 00 grooved	$\frac{3}{8}$	105	132 00
124762	No. 000 grooved	$\frac{7}{16}$	115	144 00
82805	No. 0000 grooved	$\frac{1}{2}$	125	156 00
<b>Length, 12 Inches</b>				
126976	No. 0 Fig. 8	$\frac{5}{16}$	85	105 00
126977	No. 00 Fig. 8	$\frac{3}{8}$	90	115 00
126978	No. 000 Fig. 8	$\frac{7}{16}$	100	125 00
126980	No. 0000 Fig. 8	$\frac{1}{2}$	105	135 00
<b>Length, 15 Inches</b>				
139742	No. 0 Fig. 8	$\frac{5}{16}$	105	122 00
139743	No. 00 Fig. 8	$\frac{3}{8}$	110	132 00
139745	No. 000 Fig. 8	$\frac{7}{16}$	120	144 00
139747	No. 0000 Fig. 8	$\frac{1}{2}$	125	156 00



TYPE G

Order by Style Number

TROLLEY EARS—Continued

TYPE F SCREW CLAMPING EARS



TYPE F-6



TYPE F-6-D

Type F-3, Length 5-inch

Style No.	Castings	Size Trolley Wire	PER 100	
			Wt., Lbs.	List Price
47931	Malleable iron sherardized	No. 00-0000 grooved	70	\$ 50 00
120483	Malleable iron sherardized	No. 0-00 Fig. 8	70	50 00
109340	Malleable iron sherardized	No. 000-0000 Fig. 8	70	50 00
125739	Bronze	No. 0 round	85	100 00
125740	Bronze	No. 00 round	85	100 00
125741	Bronze	No. 000 round	85	100 00
125743	Bronze	No. 0000 round	85	100 00
50385	Bronze	No. 00-0000 grooved	80	100 00
125745	Bronze	No. 0-00 Fig. 8	80	100 00
125746	Bronze	No. 000-0000 Fig. 8	80	100 00



TYPE F-3

Type F-4, Length 7-inch

82672	Malleable iron sherardized	No. 00-0000 grooved	80	58 00
120563	Malleable iron sherardized	No. 0-00 Fig. 8	80	58 00
116800	Malleable iron sherardized	No. 000-0000 Fig. 8	80	58 00
121610	Bronze	No. 0 round	90	120 00
125747	Bronze	No. 00 round	90	120 00
125748	Bronze	No. 000 round	90	120 00
125750	Bronze	No. 0000 round	90	120 00
82671	Bronze	No. 00-0000 grooved	85	120 00
125752	Bronze	No. 0-00 Fig. 8	85	120 00
125753	Bronze	No. 000-0000 Fig. 8	85	120 00



TYPE F-4

Type F-6, Length 9-inch

125754	Malleable iron sherardized	No. 00-0000 grooved	115	70 00
125755	Bronze	No. 00-0000 grooved	125	160 00

Type F-4-D, Length 10-inch

49372	Malleable iron sherardized	No. 00-0000 grooved	100	84 00
120484	Malleable iron sherardized	No. 0-00 Fig. 8	100	84 00
120485	Malleable iron sherardized	No. 000 0000 Fig. 8	100	84 00
49373	Bronze	No. 00-0000 grooved	100	170 00



TYPE F-4-D

Type F-6-D, Length 14-inch

152937	Malleable iron sherardized	No. 00-0000 grooved	185	110 00
152938	Malleable iron sherardized	No. 00-0000 Fig. 8	185	110 00

These ears can be furnished with 1/4-inch taps at the same price.

TYPE FP EARS



MALLEABLE IRON—SHERARDIZED—  
LENGTH 4 1/2 INCHES

Style No.	Size Trolley Wire	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
250467	Steel screws	5/8	45	\$46 00
250468	Brass screws	5/8	45	52 90
264093	Steel screws	5/8	45	46 00
264094	Brass screws	5/8	45	52 90

BRONZE FEEDER EARS



TYPE E TINNED



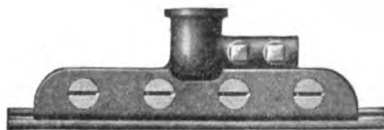
TYPE G TINNED

Style No.	Type	Length Inches	Size Wire	Diam. Tap Inches	PER 100	
					Wt. Lbs.,	List Price
48649	E	15	No. 0 round	5/8	105	\$156 00
48650	E	15	No. 00 round	5/8	110	164 00
82873	E	15	No. 000 round	5/8	120	180 00
82874	E	15	No. 0000 round	5/8	125	190 00
125788	G	15	No. 0 grooved	5/8	105	187 00
99404	G	15	No. 00 grooved	5/8	110	197 00
125789	G	15	No. 000 grooved	5/8	120	216 00
99402	G	15	No. 0000 grooved	5/8	125	228 00

Order by Style Number

## TROLLEY EARS—Continued

## BRONZE FEEDER EARS—Continued

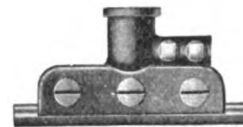


TYPE F-4



TYPE FP-4

Style No.	Type	Length Inches	Size Trolley Wire	Diam. Tap Inches	PER 100	
					Wt., Lbs.	List Price
125725	F-3	4	No. 0 round	$\frac{5}{8}$	80	\$120 00
125726	F-3	4	No. 00 round	$\frac{5}{8}$	80	120 00
125727	F-3	4	No. 0000 round	$\frac{5}{8}$	80	120 00
125729	F-3	4	No. 0000 round	$\frac{5}{8}$	80	120 00
125247	F-3	4	No. 00-0000 grooved	$\frac{5}{8}$	80	120 00
125731	F-3	4	No. 0-00 Fig. 8	$\frac{5}{8}$	80	120 00
125732	F-3	4	No. 000-0000 Fig. 8	$\frac{5}{8}$	80	120 00
125733	F-4	7	No. 0 round	$\frac{5}{8}$	115	140 00
125734	F-4	7	No. 00 round	$\frac{5}{8}$	115	140 00
125735	F-4	7	No. 0000 round	$\frac{5}{8}$	115	140 00
125737	F-4	7	No. 0000 round	$\frac{5}{8}$	115	140 00
48653	F-4	7	No. 00-0000 grooved	$\frac{5}{8}$	105	140 00
125547	F-4	7	No. 0-00 Fig. 8	$\frac{5}{8}$	105	140 00
109341	F-4	7	No. 000-0000 Fig. 8	$\frac{5}{8}$	105	140 00
160905	FP-4	7	No. 00-0000 grooved	..	90	120 00
251711	FP-3	4	No. 00-0000 grooved	..	50	100 00



TYPE F-3



TYPE FP-3

## DOUBLE STRAIN EARS

Style No.	Type	Description	Length Inches	Size Wire	Diam. Tap Inches	PER 100	
						Wt., Lbs.	List Price
85329	E	Bronze	15	No. 0 round	$\frac{5}{8}$	115	\$165 00
85330	E	Bronze	15	No. 00 round	$\frac{5}{8}$	125	175 00
85332	E	Bronze	15	No. 000 round	$\frac{5}{8}$	140	200 00
85334	E	Bronze	15	No. 0000 round	$\frac{5}{8}$	145	210 00
49362	E	Bronze	19	No. 0 round	$\frac{5}{8}$	160	170 00
49363	E	Bronze	19	No. 00 round	$\frac{5}{8}$	165	180 00
82797	E	Bronze	19	No. 000 round	$\frac{5}{8}$	165	220 00
82798	E	Bronze	19	No. 0000 round	$\frac{5}{8}$	170	230 00
125781	G	Bronze	12	No. 0 grooved	$\frac{5}{8}$	90	170 00
82787	G	Bronze	12	No. 00 grooved	$\frac{5}{8}$	105	182 00
125783	G	Bronze	12	No. 0000 grooved	$\frac{5}{8}$	115	212 00
82789	G	Bronze	12	No. 0000 grooved	$\frac{5}{8}$	120	224 00
125782	G	Bronze	15	No. 0 grooved	$\frac{5}{8}$	125	198 00
82791	G	Bronze	15	No. 00 grooved	$\frac{5}{8}$	120	210 00
125785	G	Bronze	15	No. 000 grooved	$\frac{5}{8}$	130	240 00
82793	G	Bronze	15	No. 0000 grooved	$\frac{5}{8}$	135	252 00
82735	F	Malleable iron	12	No. 00-0000 grooved	$\frac{5}{8}$	145	140 00
125756	F	Malleable iron	12	No. 0-00 Fig. 8	$\frac{5}{8}$	145	140 00
125757	F	Malleable iron	12	No. 000-0000 Fig. 8	$\frac{5}{8}$	145	140 00
47933	F	Bronze	12	No. 00-0000 grooved	$\frac{5}{8}$	160	225 00
125758	F	Bronze	12	No. 0-00 Fig. 8	$\frac{5}{8}$	160	225 00
125759	F	Bronze	12	No. 000-000 Fig. 8	$\frac{5}{8}$	160	225 00



TYPE E TINNED



TYPE G TINNED



TYPE F

## HALF STRAIN EARS

Style No.	Type	Description	Length	Size Wire	PER 100	
					Wt., Lbs.	List Price
48645	E	Bronze	8	No. 0 round	55	\$96 00
48646	E	Bronze	8	No. 00 round	60	100 00
48647	E	Bronze	8	No. 000 round	65	104 00
48648	E	Bronze	8	No. 0000 round	70	108 00
119917	G	Bronze	8	No. 0 grooved	70	115 00
125552	G	Bronze	8	No. 00 grooved	70	120 00
119918	G	Bronze	8	No. 000 grooved	75	125 00
125553	G	Bronze	8	No. 0000 grooved	75	130 00
119915	G	Bronze	8	No. 0 Fig. 8	60	115 00
125554	G	Bronze	8	No. 00 Fig. 8	60	130 00
119914	G	Bronze	8	No. 000 Fig. 8	65	125 00
125555	G	Bronze	8	No. 0000 Fig. 8	65	130 00
126269	F-4	Bronze	8	No. 00-0000 grooved	100	100 00
126270	F-4	Bronze	8	No. 0-00 Fig. 8	90	100 00
126271	F-4	Bronze	8	No. 000-0000 Fig. 8	95	100 00



TYPE E TINNED



TYPE G TINNED



TYPE F-4

These ears can be furnished with  $\frac{3}{8}$ -inch taps at the same price.

Order by Style Number

TROLLEY EARS—Continued

TYPE F-6 HALF STRAIN

Malleable Iron—Sherardized—Length, 12 Inches



Style No. 171653  
Size Trolley Wire No. 00-0000 grooved

Per 100	
Wt., Lbs.	List Price
150	\$140 00

TYPE F-6 HALF STRAIN

DOUBLE CENTER BRONZE STRAIN EAR



15 INCHES LONG TINNED FOR SOLDERING  
Distance between bosses 7 1/4 inches center to center

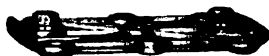
Style No.	Size Wire	Diam. Tap Inches	PER 100	
			Wt., Lbs.	List Price
85416	No. 0 round	5/8	110	\$185 00
85417	No. 00 round	5/8	110	175 00
85418	No. 000 round	5/8	125	200 00
85419	No. 0000 round	5/8	125	210 00
125778	No. 0 grooved	5/8	115	198 00
85421	No. 00 grooved	5/8	115	210 00
125779	No. 000 grooved	5/8	130	240 00
85422	No. 0000 grooved	5/8	130	252 00

MALLEABLE IRON STRAIN PLATES

Sherardized



FORM 1



FORM 2



FORM 3

Style No.	Form	Diam. Bolts For Trolley Ear, Inches	Diam. Tap for Hanger Stud, Inches	PER 100	
				Wt., Lbs.	List Price
82738	1	5/8	5/8	350	\$180 00
125724	2	5/8	5/8	450	180 00
181863	3	5/8	5/8	500	180 00

CLEVELAND TROLLEY WIRE SPLICERS



LENGTH, 16 INCHES WITHOUT BOSS



LENGTH, 19 INCHES WITH BOSS

Style No.	Size Wire	Length Inches	PER 100	
			Wt., Lbs.	List Price
<b>Short Length Without Boss</b>				
305889	No. 0 round	16	187	\$320 00
305890	No. 00 round	16	200	350 00
305891	No. 000 round	16	225	385 00
305892	No. 0000 round	16	275	425 00
305893	No. 00 grooved	16	200	350 00
305894	No. 000 grooved	16	225	385 00
305895	No. 0000 grooved	16	237	425 00
<b>Regular Length Without Boss</b>				
305896	No. 0 round	19	225	380 00
305897	No. 00 round	19	250	400 00
305898	No. 000 round	19	275	440 00
305899	No. 0000 round	19	300	480 00
305700	No. 00 grooved	19	250	400 00
305701	No. 000 grooved	19	275	440 00
305702	No. 0000 grooved	19	300	480 00

Order by Style Number

CLEVELAND TROLLEY WIRE SPLICERS—Continued

Regular Length With 5/8-Inch Boss

Style No.	Size Wire	Length Inches	PER 100	
			Wt., Lbs.	List Price
305703	No. 0 round	19	250	\$400 00
305704	No. 00 round	19	275	440 00
305705	No. 000 round	19	300	480 00
305706	No. 0000 round	19	325	530 00
305707	No. 00 grooved	19	275	440 00
305708	No. 000 grooved	19	300	480 00
305709	No. 0000 grooved	19	325	530 00



LENGTH 30 INCHES WITH BOSS

Special Length Without Boss

226048	No. 00 grooved	30	400	600 00
175932	No. 000 grooved	30	430	640 00
169771	No. 0000 grooved	30	462	700 00
226044	No. 00 round	30	400	600 00
226049	No. 000 round	30	430	640 00
169769	No. 0000 round	30	462	700 00

Special Length With 5/8-Inch Boss

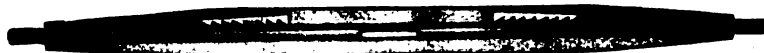
169873	No. 00 round	30	425	640 00
226050	No. 000 round	30	455	680 00
169768	No. 0000 round	30	487	740 00
226046	No. 00 grooved	30	425	640 00
226052	No. 000 grooved	30	455	680 00
169770	No. 0000 grooved	30	487	740 00

STANDARD SPLICING SLEEVES



Style No.	Size Trolley Wire	Length and Greatest Diameter Inches	PER 100	
			Wt., Lbs.	List Price
87514	No. 0 round	10x5/8	48	\$132 00
87513	No. 0 round	15x5/8	75	180 00
87516	No. 00 round or 0 grooved	10x5/8	45	132 00
87515	No. 00 round or 0 grooved	16x5/8	76	200 00
141146	No. 00 round or 0 grooved	18x5/8	84	270 00
92232	No. 000 round or 00 grooved	11x5/8	70	200 00
87517	No. 000 round or 00 grooved	18x5/8	115	300 00
92233	No. 0000 round or 000 grooved	12x5/8	104	270 00
87518	No. 0000 round or 000 grooved	20x5/8	174	420 00
92234	No. 0000 grooved	12x5/8	104	270 00
87519	No. 0000 grooved	20x5/8	164	420 00

EMERGENCY SPLICING SLEEVES



MADE OF EXTRA STRONG BRONZE

Style No.	Size Trolley Wire	Length Inches	Greatest Diam. Inches	PER 100	
				Wt., Lbs.	List Price
247941	No. 0 round	10	3/8	69	\$130 00
247942	No. 00 round or 0 grooved	10	3/8	70	140 00
247943	No. 000 round or 00 grooved	10	3/8	83	160 00
247944	No. 0000 round or 000 grooved	15	3/8	120	200 00
247945	No. 0000 grooved	15	3/8	137	220 00
247946	No. 0 round in one end and 00 grooved in other end	10	3/8	85	160 00
247947	No. 00 Fig. 8	10	..	63	140 00
247948	No. 000 Fig. 8	15	..	100	200 00
247949	No. 0000 Fig. 8	15	..	159	220 00
140183	Extra steel wedges for above	..	..	..	8 00

Order by Style Number

## TYPE U TROLLEY WIRE SPLICERS

(Patented)



10-INCH WITHOUT BOSS



15-INCH WITH 1/8-INCH BOSS

Style No.	Description	Size Wire	Length Inches	PER 100	
				Wt., Lbs.	List Price
279145	Bronze without boss	No. 0 and 00 round and grooved	10	100	\$170 00
279146	Bronze without boss	No. 000 round and grooved	10	120	180 00
279147	Bronze without boss	No. 0000 round and grooved	10	130	200 00
279148	Bronze with 1/8-inch boss	No. 0 and 00 round and grooved	15	185	275 00
279149	Bronze with 1/8-inch boss	No. 000 round and grooved	15	190	285 00
279151	Bronze with 1/8-inch boss	No. 0000 round and grooved	15	210	300 00

## CLARK SPLICING EARS



FORM 1  
BRONZE—LENGTH 12 INCHES



FORM 3  
BRONZE—LENGTH 15 INCHES

Style No.	Form	Size Wire	Diam. Tap Inches	PER 100	
				Wt., Lbs.	List Price
<b>Length, 12 inches without Boss</b>					
125794	1	No. 0 Fig. 8	No boss	85	\$176 00
125795	1	No. 00 Fig. 8	No boss	90	194 00
119890	1	No. 000 Fig. 8	No boss	100	216 00
119891	1	No. 0000 Fig. 8	No boss	105	230 00
<b>Length, 15 inches with Boss</b>					
154794	3	No. 0 Fig. 8	5/8	150	290 00
154795	3	No. 00 Fig. 8	5/8	150	300 00
154796	3	No. 000 Fig. 8	5/8	165	320 00
154797	3	No. 0000 Fig. 8	5/8	165	340 00
<b>Combination Splicers with Boss</b>					
121561	3	No. 0 round and 00 Fig. 8	5/8	115	320 00
126387	3	No. 00 round and 00 Fig. 8	5/8	115	330 00
121562	3	No. 000 round and 00 Fig. 8	5/8	125	340 00
151111	3	No. 0000 round and 0000 Fig. 8	5/8	160	350 00

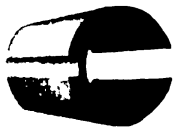
## TYPE SL SET SCREW SPLICER



LENGTH 10 INCHES

Style No.	Size Wire	PER 100	
		Wt., Lbs.	List Price
375667	No. 0 and No. 00 round, grooved, and Fig. 8	135	\$220 00
375668	No. 000 and No. 0000 round, grooved, and Fig. 8	135	240 00

## TROLLEY WIRE CHUCKS



Size Wire	Round Wire	Grooved Wire	Fig. 8 Wire	List Price Per 100	
				Wt., Lbs.	Price
0	167524	163416	145973	42	00
00	163416	167525	145974	42	00
000	167526	167527	145975	42	00
0000	167528	167529	145976	42	00

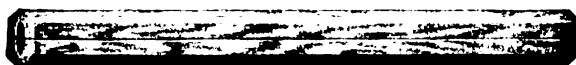
## TROLLEY PROTECTING ARMOR

COPPER

Style No.	SIZE TROLLEY WIRE			Approx. Wt., Lbs. Per 100	List Price Per 100
	Round	Grooved	Fig. 8		
135094	0	.....	.....	60	\$180 00
135095	00	0	0	65	200 00
135096	000	00	.....	75	210 00
135097	.....	000	00	75	240 00
135098	0000	.....	000	80	250 00
135099	.....	0000	.....	85	260 00
135100	.....	.....	0000	90	275 00

Order by Style Number

## WOODEN CONTACT INSULATORS



Style No.	Length Inches	Diam. Hole Inches	Wt., Lbs.	PER 100	List Price
126962	12	5/8	42		\$50 00
126966	12	3/8	84		50 00
126970	12	1 1/8	141		60 00
126963	18	5/8	63		55 00
126967	18	3/8	126		55 00
126971	18	1 1/8	211		65 00

## TROLLEY FROGS DETROIT TROLLEY FROGS



For Any Degree of Turnout

STYLE No.		Turn-out	Size and Type of Wire	Overall Length, Inches	EACH LIST PRICE		
Malleable Iron Bodies	Bronze Bodies				Net Wt., Lbs.	Malleable Iron Bodies	Bronze Bodies
167514*	167510*	Right-hand	00 round or grooved	37 1/2	14	\$11 00	\$16 00
146360	146356	Right-hand	000 round or grooved	37 1/2	14	11 00	18 00
146361	146357	Right-hand	0000 round or grooved	37 1/2	14	11 00	18 00
183148	159493	Right-hand	00 Fig. 8	37 1/2	14	11 00	18 00
183149	159494	Right-hand	000 Fig. 8	37 1/2	14	11 00	18 00
183150	159495	Right-hand	0000 Fig. 8	37 1/2	14	11 00	18 00
167516*	167512*	Left-hand	00 *round or grooved	37 1/2	14	11 00	18 00
146370	146366	Left-hand	000 round or grooved	37 1/2	14	11 00	18 00
146371	146367	Left-hand	0000 round or grooved	37 1/2	14	11 00	18 00
183151	159497	Left-hand	00 Fig. 8	37 1/2	14	11 00	18 00
183152	159498	Left-hand	000 Fig. 8	37 1/2	14	11 00	18 00
183153	159499	Left-hand	0000 Fig. 8	37 1/2	14	11 00	18 00

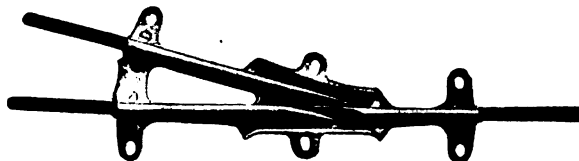
\*Covers frogs specially adapted for use with shallow 3 and 4-inch wheels. These will work equally well with the standard interurban wheel.

### V-Shaped Detroit Frogs

STYLE No.		Size and Type of Wire	Net Wt., Lbs.	EACH LIST PRICE	
Malleable Iron Bodies	Bronze Bodies			Malleable Iron Bodies	Bronze Bodies
162390	162386	00 round or grooved†	14	\$11 00	\$16 00
162391	162387	000 round or grooved†	14	11 00	18 00
162392	162388	0000 round or grooved†	14	11 00	18 00

†Can be furnished for Fig. 8 wire when specified.

## TYPE CR TROLLEY FROGS 15 Degrees



Malleable Iron Body Sherardized, With Bronze Approaches

Style No.	Turn-out	Size and Type of Wire	Overall Length, Inches	Net. Wt., Lbs.	EACH LIST PRICE
293677	Right-hand	00 round or grooved	32	13 1/2	\$9 00
293678	Right-hand	000 round or grooved	32	13 1/2	9 00
293679	Right-hand	0000 round or grooved	32	13 1/2	9 00
293680	Right-hand	00 Fig. 8	32	13 1/2	9 00
293681	Right-hand	000 Fig. 8	32	13 1/2	9 00
293682	Right-hand	0000 Fig. 8	32	13 1/2	9 00
293683	Left-hand	00 round or grooved	32	13 1/2	9 00
293684	Left-hand	000 round or grooved	32	13 1/2	9 00
293685	Left-hand	0000 round or grooved	32	13 1/2	9 00
293686	Left-hand	00 Fig. 8	32	13 1/2	9 00
293687	Left-hand	000 Fig. 8	32	13 1/2	9 00
293688	Left-hand	0000 Fig. 8	32	13 1/2	9 00

Order by Style Number

TROLLEY FROGS—Continued

TYPE CR TROLLEY FROGS—Continued

8 Degrees



Malleable Iron Body Sherardized, With Bronze Approaches

Style No.	Turn-out	Size and Type of Wire	Overall Length, Inches	EACH	
				Net Wt., Lbs.	List Price
306090	Right-hand	00 round or grooved	32	13 3/4	\$9 00
306091	Right-hand	000 round or grooved	32	13 3/4	9 00
306092	Right-hand	0000 round or grooved	32	13 3/4	9 00
306093	Right-hand	00 Fig. 8	32	13 3/4	9 00
306094	Right-hand	000 Fig. 8	32	13 3/4	9 00
306095	Right-hand	0000 Fig. 8	32	13 3/4	9 00
306096	Left-hand	00 round or grooved	32	13 3/4	9 00
306097	Left-hand	000 round or grooved	32	13 3/4	9 00
306098	Left-hand	0000 round or grooved	32	13 3/4	9 00
306099	Left-hand	00 Fig. 8	32	13 3/4	9 00
306100	Left-hand	000 Fig. 8	32	13 3/4	9 00
306101	Left-hand	0000 Fig. 8	32	13 3/4	9 00

TYPE CR UNIVERSAL FROGS

12 Degrees



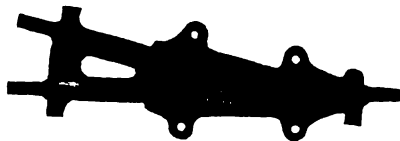
Malleable Iron Body Sherardized, With Set Screw Approaches

Style No.	Turn-out	Size and Type of Wire	Overall Length, Inches	EACH	
				Net Wt., Lbs.	List Price
370914	Right-hand	00 round or grooved	32	13 3/4	\$9 00
370915	Right-hand	000 round or grooved	32	13 3/4	9 00
370916	Right-hand	0000 round or grooved	32	13 3/4	9 00
370917	Left-hand	00 round or grooved	32	13 3/4	9 00
370918	Left-hand	000 round or grooved	32	13 3/4	9 00
370919	Left-hand	0000 round or grooved	32	13 3/4	9 00

TYPE MK TROLLEY FROGS (Patented)

Malleable Iron Body Sherardized, With Bronze Approaches

15 Degrees



Style No.	Turn-out	Size and Type of Wires	Overall Length, Inches	EACH	
				Net Wt., Lbs.	List Price
311652	Right-hand	00 round or grooved	21	10	\$7 60
311653	Right-hand	000 round or grooved	21	10	7 60
311654	Right-hand	0000 round or grooved	21	10	7 60
311655	Right-hand	00 Fig. 8	21	10	7 60
311656	Right-hand	000 Fig. 8	21	10	7 60
311657	Right-hand	0000 Fig. 8	21	10	7 60
311658	Left-hand	00 round or grooved	21	10	7 60
311659	Left-hand	000 round or grooved	21	10	7 60
311660	Left-hand	0000 round or grooved	21	10	7 60
311661	Left-hand	00 Fig. 8	21	10	7 60
311662	Left-hand	000 Fig. 8	21	10	7 60
311663	Left-hand	0000 Fig. 8	21	10	7 60

20 Degrees

311676	Right-hand	00 round or grooved	18	9	7 10
311677	Right-hand	000 round or grooved	18	9	7 10
311678	Right-hand	0000 round or grooved	18	9	7 10
311679	Left-hand	00 round or grooved	18	9	7 10
311680	Left-hand	000 round or grooved	18	9	7 10
311681	Left-hand	0000 round or grooved	18	9	7 10
311682	Right-hand	00 Fig. 8	18	9	7 10
311683	Right-hand	000 Fig. 8	18	9	7 10
311684	Right-hand	0000 Fig. 8	18	9	7 10
311685	Left-hand	00 Fig. 8	18	9	7 10
311686	Left-hand	000 Fig. 8	18	9	7 10
311687	Left-hand	0000 Fig. 8	18	9	7 10

15-Degree V-Shape

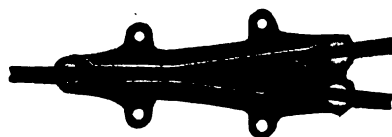
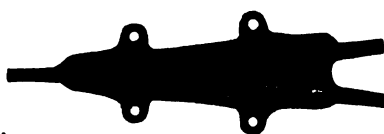
370921	00 round or grooved	10	7 60
370922	000 round or grooved	10	7 60
370923	0000 round or grooved	10	7 60
372199	00 Fig. 8	10	7 60
372200	000 Fig. 8	10	7 60
372201	0000 Fig. 8	10	7 60

Order by Style Number



TROLLEY FROGS—Continued

BRONZE TROLLEY FROGS



Style No. without Wearing Plate	Style No. with Wearing Plate	Description	EACH		
			Net Weight Pounds	List Price without Wearing Plate	List Price with Wearing Plate
<b>Twenty-Degree Angle</b>					
249377	159464	Right hand for 0-00 round, grooved, or Fig. 8 wire	7	\$8 40	\$8 60
249378	159465	Right hand for 000-0000 round, grooved, or Fig. 8 wire	7½	9 00	9 20
249379	159466	Left hand for 0-00 round, grooved, or Fig. 8 wire	7	8 40	8 60
249380	159467	Left hand for 000-0000 round, grooved, or Fig. 8 wire	7½	9 00	9 20
249381	159468	V-shape for 0-00 round, grooved, or Fig. 8 wire	7	8 40	8 60
249382	159469	V-shape for 000-0000 round, grooved, or Fig. 8 wire	7½	9 00	9 20
<b>Fifteen-Degree Angle</b>					
249383	159470	Right hand for 0-0000 round, grooved, or Fig. 8 wire	8	10 50	10 70
249384	159471	Left hand for 0-0000 round, grooved, or Fig. 8 wire	8	10 50	10 70
249385	159472	V-shape for 0-0000 round, grooved, or Fig. 8 wire	8	10 50	10 70
<b>Eight-Degree Angle</b>					
249386	159473	Right hand for 0-0000 round, grooved, or Fig. 8 wire	9	13 00	13 20
249387	159474	Left hand for 0-0000 round, grooved, or Fig. 8 wire	9	13 00	13 20
249388	159475	V-shape for 0-0000 round, grooved, or Fig. 8 wire	9	13 00	13 20

TYPE W TROLLEY FROGS

15 Degrees, 3-Way

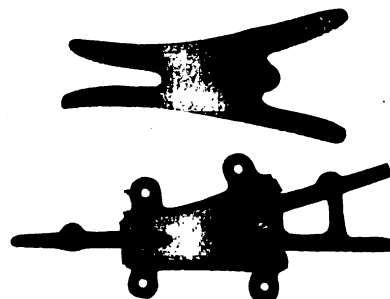
Bronze Body



Style No.	Size and Type of Wire	EACH	
		Wt., Lbs.	List Price
186838	00 round or grooved	18½	\$20 00
186839	000 round or grooved	18½	20 00
186840	0000 round or grooved	18½	20 00
188323	00 Fig. 8	18½	20 00
188324	000 Fig. 8	18½	20 00
188325	0000 Fig. 8	18½	20 00

WEARING PLATES FOR TROLLEY FROGS AND CROSSINGS

Style No.	Adaptation	PER 100—	
		Wt., Lbs.	List Price
125927	For 20 degree right-hand or left hand frogs	50	\$20 00
125928	For 20 degree V-shape frogs	50	20 00
125929	For 15 degree right-hand or left-hand frogs	50	20 00
125930	For 15 degree V-shaped frogs	50	20 00
125931	For 8 degree right-hand, left-hand or V-shape frogs	50	20 00
127205	For 30-90 degree adjustable crossings, No. 127209 and No. 123917	50	20 00
127206	For 90 degree rigid crossings, No. 127210 and No. 49380	50	20 00
127207	For 35 degree rigid crossing, No. 126032	50	20 00
127208	For 15 degree rigid crossing, No. 49383	50	20 00



Order by Style Number

# APPROACHES

## Bronze



FOR ROUND OR GROOVED WIRE



FOR FIG. 8 WIRE

### FLEXIBLE APPROACHES

Style No.	Length Inches	Size and Type of Wire	PER 100	
			Wt., Lbs.	List Price
241022	6	0 round or grooved	65	\$100 00
188424	6	00 round or grooved	70	100 00
188425	6	0000 round or grooved	75	100 00
188426	6	0000 round or grooved	80	100 00
188427	6	0 Fig. 8	65	100 00
188428	6	00 Fig. 8	70	100 00
188429	6	000 Fig. 8	75	100 00
188430	6	0000 Fig. 8	80	100 00

### APPROACHES FOR MK FROGS

Style No.	Length Inches	Size and Type of Wire	PER 100	
			Wt., Lbs.	List Price
266310	2 1/2	00 round or grooved	50	\$80 00
266311	2 1/2	000 round or grooved	50	80 00
266312	2 1/2	0000 round or grooved	50	80 00
266313	2 1/2	00 Fig. 8	50	80 00
266314	2 1/2	000 Fig. 8	50	80 00
266315	2 1/2	0000 Fig. 8	50	80 00

### SET SCREW APPROACHES

Style No.	Length Inches	Size and Type of Wire	PER 100	
			Wt., Lbs.	List Price
371943	6	00 round or grooved	50	\$100 00
371944	6	000 round or grooved	62 1/2	100 00
371945	6	0000 round or grooved	75	100 00
371946	2 1/2	00 round or grooved	25	80 00
371947	2 1/2	000 round or grooved	25	80 00
371948	2 1/2	0000 round or grooved	25	80 00
370081	2 1/2	00 Fig. 8	25	80 00
370082	2 1/2	000 Fig. 8	25	80 00
370083	2 1/2	0000 Fig. 8	25	80 00

# RIGID METALLIC CROSSINGS



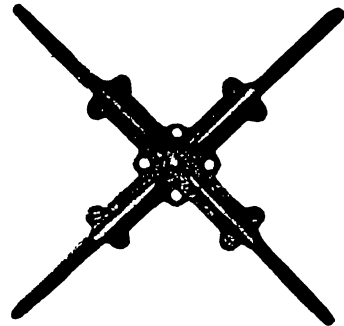
18-DEGREE CROSSING

STYLE NUMBER		Size and Type of Wire	Total Overall Length, Inches	Weight, Lbs.	EACH LIST PRICE	
Malleable Iron Body	Bronze Body				Malleable Iron Body	Bronze Body
<b>15-Degree Crossings</b>						
181537	181534	00 round or grooved	35 1/4	15	\$11 00	\$16 00
181538	181535	000 round or grooved	35 1/4	15	11 00	16 00
181539	181536	0000 round or grooved	35 1/4	15	11 00	16 00
181543	181540	00 Fig. 8	35 1/4	15	11 00	16 00
181544	181541	000 Fig. 8	35 1/4	15	11 00	16 00
181545	181542	0000 Fig. 8	35 1/4	15	11 00	16 00
<b>18-Degree Crossings</b>						
181555	181552	00 round or grooved	35 1/2	13	11 00	16 00
181556	181553	000 round or grooved	35 1/2	13	11 00	16 00
181557	181554	0000 round or grooved	35 1/2	13	11 00	16 00
181561	181558	00 Fig. 8	35 1/2	13	11 00	16 00
181562	181559	000 Fig. 8	35 1/2	13	11 00	16 00
181563	181560	0000 Fig. 8	35 1/2	13	11 00	16 00
<b>23-Degree Crossings</b>						
181573	181570	00 round or grooved	30 3/4	12	10 00	15 00
181574	181571	000 round or grooved	30 3/4	12	10 00	15 00
181575	181572	0000 round or grooved	30 3/4	12	10 00	15 00
181579	181576	00 Fig. 8	30 3/4	12	10 00	15 00
181580	181577	000 Fig. 8	30 3/4	12	10 00	15 00
181581	181578	0000 Fig. 8	30 3/4	12	10 00	15 00

Order by Style Number

**RIGID METALLIC CROSSINGS—Continued**

STYLE NUMBER		Size and Type of Wire	Total Overall Length, Inches	Weight, Lbs.	EACH LIST PRICE	
Malleable Iron Body	Bronze Body				Malleable	Bronze
<b>35-Degree Crossings</b>						
181591	181588	00 round or grooved	23 1/2	10	\$10 00	\$15 00
181592	181589	000 round or grooved	23 1/2	10	10 00	15 00
181593	181590	0000 round or grooved	23 1/2	10	10 00	15 00
181597	181594	00 Fig. 8	23 1/2	10	10 00	15 00
181598	181595	000 Fig. 8	23 1/2	10	10 00	15 00
181599	181596	0000 Fig. 8	23 1/2	10	10 00	15 00
<b>90-Degree Crossings</b>						
181608	181605	00 round or grooved	23 3/4	11	9 00	12 00
181609	181606	000 round or grooved	23 3/4	11	9 00	12 00
181610	181607	0000 round or grooved	23 3/4	11	9 00	12 00
181614	181611	00 Fig. 8	23 3/4	11	9 00	12 00
181615	181612	000 Fig. 8	23 3/4	11	9 00	12 00
181616	181613	0000 Fig. 8	23 3/4	11	9 00	12 00



90-DEGREE CROSSING

**ADJUSTABLE METALLIC CROSSINGS**

For Angles of 30 to 90 Degrees

STYLE NUMBER		Size and Type of Wire	Weight, Lbs.	EACH LIST PRICE	
Malleable Iron Body	Bronze Body			Malleable	Bronze
<b>Form 1</b>					
181627	154072	00 round or grooved	18	\$12 00	\$16 00
181628	157151	000 round or grooved	18	12 00	16 00
181629	157152	0000 round or grooved	18	12 00	16 00
181633	181630	00 Fig. 8	18	12 00	16 00
181634	181631	000 Fig. 8	18	12 00	16 00
181635	181632	0000 Fig. 8	18	12 00	16 00
<b>Form 2</b>					
181645	181642	00 round or grooved	20	13 00	17 00
181646	181643	000 round or grooved	20	13 00	17 00
181647	181644	0000 round or grooved	20	13 00	17 00
181651	181648	00 Fig. 8	20	13 00	17 00
181652	181649	000 Fig. 8	20	13 00	17 00
181653	181650	0000 Fig. 8	20	13 00	17 00



FORM 1—METALLIC



FORM 2—METALLIC

**RIGID INSULATED CROSSINGS**

For Voltages up to 750



Style No.	Crossing Angle	Size and Type of Wire	Overall Length, Inches	EACH	
				Wt., Lbs.	List Price
370930	15-degree, right-hand	00 round or grooved	72	30	\$36 00
370931	15-degree, right-hand	000 round or grooved	72	30	36 00
370932	15-degree, right-hand	0000 round or grooved	72	30	36 00
370933	15-degree, left-hand	00 round or grooved	72	30	36 00
370934	15-degree, left-hand	000 round or grooved	72	30	36 00
370935	15-degree, left-hand	0000 round or grooved	72	30	36 00

**TYPE KD ADJUSTABLE INSULATED CROSSINGS**

For Voltages up to 750



STYLE NUMBER		Size and Type of Wire	Wt., Lbs. Each	LIST PRICE EACH	
Malleable Iron End Castings	Bronze End Castings			Malleable Iron End Castings	Bronze End Castings
163691	163687	00 round or grooved	19	\$30 00	\$35 00
163692	163688	000 round or grooved	19	30 00	35 00
163693	163689	0000 round or grooved	19	30 00	35 00
181859	Micarta runner only (Two required per crossing)		1	2 25	2 25

Order by Style Number

## SECTION INSULATORS

### TYPES HR AND HR-2 SECTION INSULATORS—750 Volts



STYLE NUMBER				Size and Type of Wire	LIST PRICE EACH				
Type HR		Type HR-2			Type HR	Type HR-2			
Malleable Iron End Castings	Bronze End Castings	Malleable Iron End Castings	Bronze End Castings	Wt., Lbs. Each	Malleable Iron End Castings	Bronze End Castings	Malleable Iron End Castings	Bronze End Castings	
163667	163663	185370	185367	00 round or grooved	18	\$18 00	\$20 00	\$16 50	\$20 50
163668	163664	185371	185368	000 round or grooved	18	18 00	20 00	16 50	20 50
163669	163665	185372	185369	0000 round or grooved	18	18 00	20 00	16 50	20 50
184200	Complete extra runners. (Two required per insulator.)				1	2 60	2 60	2 60	2 60

### TYPE KB SECTION INSULATORS



#### 750 Volts

STYLE NUMBER			Size Wire	EACH	
Round Wire	Grooved Wire	Fig. 8 Wire		Wt., Lbs.	List Price
199175	199179	199183	0	15	\$18 00
199178	199180	199184	00	15	18 00
199177	199181	199185	000	15	18 00
199178	199182	199186	0000	15	18 00
363417	Extra fiber runner for above			1	1 90
363418	Extra Micarta runner for above			1	2 40

#### 1500 Volts

STYLE NUMBER			Size Wire	EACH	
Round Wire	Grooved Wire	Fig. 8 Wire		Wt., Lbs.	List Price
248525	248527	0	27	\$20 00	
248526	248528	00	27	20 00	
248509	248511	000	27	20 00	
248510	248512	0000	27	20 00	
371951	Fiber runner for above			2	2 90
371952	Micarta runner for above			2	3 60

Regularly supplied with fiber runner. Can be furnished with Micarta runner if desired. When ordering additional runners state whether or not side bars are drilled for runners.



### SINGLE BEAM SECTION INSULATOR

Style No.	Size Wire	EACH	
		Wt., Lbs.	List Price
305710	No. 00 Round or Grooved Wire	8 1/4	\$11 30
305711	No. 000 and 0000 Round or Grooved Wire	8 3/4	11 30
305712	No. 00 Figure 8 Wire	8 1/4	11 30
305713	No. 0000 Figure 8 Wire	8 1/2	11 30



### TYPE HM SECTION INSULATORS

#### 750 Volts

Size Wire	STYLE NUMBER			Wt., Lbs.	List Price	Size Wire	STYLE NUMBER		
	Round or Grooved Wire	Figure 8 Wire	Form 1				Round or Grooved Wire	Figure 8 Wire	Form 2
0	127355	125761	3.4	\$8 80	0	187638	187645	3.4	\$9 80
00	127356	125762	3.4	8 80	00	187639	187646	3.4	9 80
000	127357	119312	3.6	8 80	000	187640	187647	3.6	9 80
0000	127358	119313	3.6	8 80	0000	187641	187648	3.6	9 80



### MINE SECTION INSULATOR WITH SWITCH

#### Type SW—For Voltages Up to 250

##### With One Supporting Lug

Round Wire	STYLE NUMBER			Size Wire	EACH	
	Grooved Wire	Fig. 8 Wire	List Price		Wt., Lbs.	List Price
262939	262939	280452	2-0	12	\$18 00	
262939	262939		3-0	12	18 00	
262940	262940	262941	4-0	12	18 00	

##### With Two Supporting Lugs

262942	262942	280453	2-0	12	18 00
262942	262942		3-0	12 1/2	18 00
262943	262943	262944	4-0	12 1/2	18 00

Order by Style Number

SECTION INSULATORS—Continued

DOUBLE-GAP SECTION INSULATOR WITH SWITCH

600 Volts

Style No.	Size and Type of Wire	EACH	
		Wt., Lbs.	List Price
320855	00 round or grooved	12	\$19 50
308108	0000 round or grooved	12	19 50
308109	00 Figure 8	12	19 50
308107	0000 Figure 8	12	19 50



AUTOMATIC SECTION INSULATOR  
750 Volts

With Rotating Boss

Style No.	Size and Type of Wire	EACH	
		Weight, Lbs.	List Price
358384	00 round or grooved	11 1/4	\$27 00
358385	0000 round or grooved	11 1/4	27 00
358386	00 figure 8	11 1/4	27 00
358387	0000 figure 8	11 1/4	27 00



With 2 Lugs

358388	00 round or grooved	11 1/4	27 00
358389	0000 round or grooved	11 1/4	27 00
358390	00 figure 8	11 1/4	27 00
358391	0000 figure 8	11 1/4	27 00

AUTOMATIC SECTION INSULATORS—  
Patented—750 Volts

Round Wire	STYLE NUMBER		Size of Wire	EACH	
	Grooved Wire	Fig. 8 Wire		Wt. Lbs.	List Price
<b>End Castings and Rocker Run-Way Bronze</b>					
144830	144831	145977	0	20	\$36 00
144831	144832	145978	00	20	38 00
144833	144834	145979	000	20	38 00
144835	143182	145980	0000	20	38 00



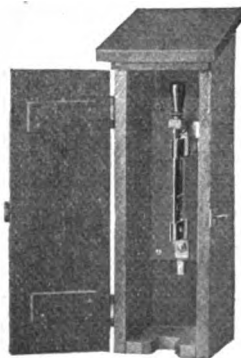
<b>End Castings and Rocker Run-Way Malleable Iron</b>					
241374	241375	241381	0	20	27 00
241375	241376	241382	00	20	27 00
241377	241378	241383	000	20	27 00
241379	241380	241384	0000	20	27 00

REPAIR PARTS FOR AUTOMATIC SECTION INSULATOR

Style No.	Description	PER 100		Style No.	Description	PER 100	
		Wt., Lbs.	List Price			Wt., Lbs.	List Price
239181	Contact jaw, right hand.....	50	\$12 00	244650	Bronze rocker run-way.....	250	\$240 00
239182	Contact jaw, left hand.....	50	12 00	256283	Malleable iron rocker run-way...	250	120 00
199263	Supporting lug.....	100	80 00	259180	Plunge rod.....	10	25 00
239183	Hickory bar.....	300	98 00	259181	Roller.....	5	10 00
247262	Shunt complete.....	100	98 00	259182	Spring.....	2	5 00
247263	Knife blade.....	50	38 00				

LINE SECTION SWITCHES

FOR VOLTAGES TO 750,  
CAPACITIES TO 600 AMPERES

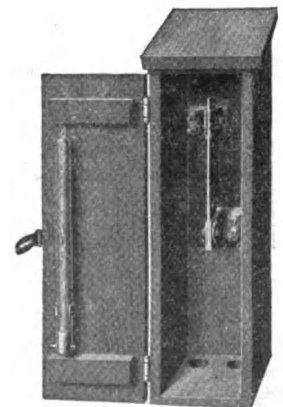


750-VOLT SWITCH IN BOX

Style No.	Capacity Amperes	Overall Height Inches	EACH	
			Wt., Lbs.	List Price
<b>With Box</b>				
272660	200	22 1/2	13	\$11 20
272662	400	26 1/2	23	14 80
272664	600	28 1/2	29	21 00
304671	800	27 1/2	32	28 80
304672	1200	33 1/2	40	37 50
<b>Without Box</b>				
272661	200	12 3/4	5	7 80
272663	400	15 1/2	10	10 80
272665	600	17 3/4	16	16 80
304673	800	15 1/4	21	24 00
304674	1200	18 1/4	30	32 00

FOR VOLTAGES TO 1500,  
CAPACITIES TO 1200 AMPERES

Style No.	Capacity, Amperes	Overall Height Inches	EACH	
			Wt., Lbs.	List Price
242866	1200	33 3/4	45	\$80 00



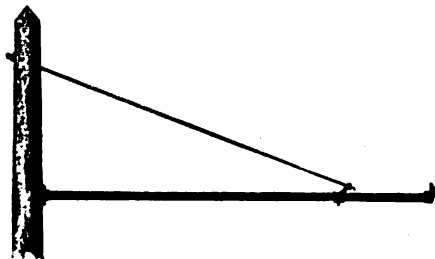
1500-VOLT SWITCH IN BOX

Order by Style Number

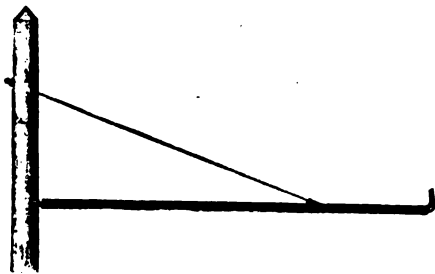
# CATENARY SUSPENSION BRACKET ARMS

## TYPE GB

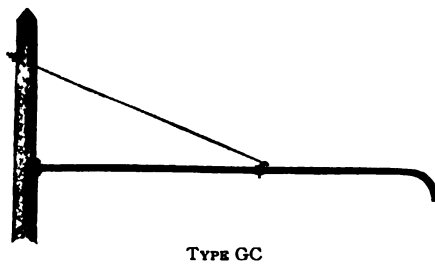
Style No.	Description	Approx. Wt., Lbs. Each	List Price Each	Style No.	Description	Approx. Wt., Lbs. Each	List Price Each
196262	9-foot arm with 1/2-inch x 8-foot, 9-inch tension rod	49	\$ 8 80	171064	9-foot arm with 3/8-inch x 8-foot, 9-inch tension rod	52	\$ 9 75
196263	10-foot arm with 1/2-inch x 9-foot, 9-inch tension rod	54	9 60	196266	10-foot arm with 3/8-inch x 9-foot, 9-inch tension rod	57	10 75
196264	11-foot arm with 1/2-inch x 10-foot, 9-inch tension rod	59	10 20	196267	11-foot arm with 3/8-inch x 10-foot, 9-inch tension rod	63	11 75
196265	12-foot arm with 1/2-inch x 11-foot, 9-inch tension rod	64	11 00	196268	12-foot arm with 3/8-inch x 11-foot, 9-inch tension rod	68	12 75



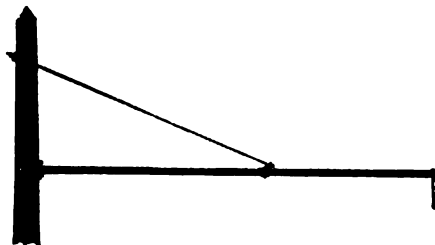
TYPE GB



TYPE CH



TYPE GC



TYPE GM

## Parts for Type GB Bracket Arm

263646	Tension rod 1/2-inch x 8 foot 9 inches	6	1 15
263647	Tension rod 1/2-inch x 9 foot 9 inches	6 3/4	1 25
306624	Tension rod 1/2-inch x 10 foot 9 inches	7 1/2	1 35
306625	Tension rod 1/2 inch x 11 foot 9 inches	8 1/4	1 45
171067	Tension rod 3/8-inch x 8 foot 9 inches.	9	1 60
184299	Tension rod 3/8-inch x 9 foot 9 inches.	10	1 75
184579	Tension rod 3/8-inch x 10 foot 9 inches	11	1 90
306627	Tension rod 3/8-inch x 11 foot 9 inches	12	2 00
171059	Pole socket sherardized.....	1.8	90
198115	Clamp for 1/2-inch tension rod, sherardized.....	2 1/2	1 00
171060	Clamp for 3/8-inch tension rod, sherardized.....	2 1/2	1 05
171061	End Casting, sherardized.....	1	75
162232	Beveled washer for 1/2-inch tension rod, sherardized.....	1/4	10
163643	Beveled washer for 3/8-inch tension rod, sherardized.....	1/4	10

## TYPE CH

175898	9-foot arm with 1/2-inch x 7-foot, 4 1/4-inch tension rod	60	10 50
175899	10-foot arm with 1/2-inch x 8-foot, 4 3/4-inch tension rod	66	11 25
175900	11-foot arm with 1/2-inch x 9-foot, 5 1/4-inch tension rod	72	12 00
175901	12-foot arm with 1/2-inch x 10-foot, 5 3/4-inch tension rod.....	78	12 75
175902	9-foot arm with 3/8-inch x 7-foot, 4 1/4-inch tension rod	63	11 50
175903	10-foot arm with 3/8-inch x 8-foot, 4 3/4-inch tension rod	70	12 50
163641	11-foot arm with 3/8-inch x 9-foot, 6-inch tension rod	77	13 50
163645	12-foot arm with 3/8-inch x 10-foot, 6-inch tension rod	84	14 50

## Parts for Type CH Bracket Arms

184094	Tension rod 1/2-inch x 7-foot 4 1/4-inch	5	1 25
184102	Tension rod 1/2-inch x 8-foot 4 3/4-inch	5.7	1 35
184104	Tension rod 1/2-inch x 9-foot 5 1/4-inch	6 1/2	1 45
185981	Tension rod 1/2-inch x 10-foot 5 3/4-inch.	7	1 55
184095	Tension rod 3/8-inch x 7-foot 4 1/4-inch	7 1/2	1 65
184103	Tension rod 3/8-inch x 8-foot 4 3/4-inch	8 1/2	1 85
163642	Tension rod 3/8-inch x 9-foot 6 -inch	9 1/2	2 00
163646	Tension rod 3/8-inch x 10-foot 6 -inch	10 1/2	2 20
67196	Pole clamp, sherardized.....	1.85	60
92236	Clamp for 1/2-inch tension rod, sherardized.....	2	3 10
163644	Clamp for 3/8-inch tension rod, sherardized.....	3	3 15
162231	End casting, sherardized.....	1	60
162232	Beveled washer for 1/2-inch tension rod, sherardized.....	1/4	10
163643	Beveled washer for 3/8-inch tension rod, sherardized.....	1/4	10

## TYPE GC EXTENSION ARM

Style No.	Length, Feet	Depression Inches	Tension Rod	Wt., Lbs. Each	List Price
175904	12 1/2	14 3/4	3/8-inch x 8-foot, 9-inch	81	\$13 50
175906	12	8 1/2	3/8-inch x 8-foot, 9-inch	78	13 50
241304	13	10 3/4	3/8-inch x 8-foot, 9-inch	85	14 50

## TYPE GM EXTENSION ARM

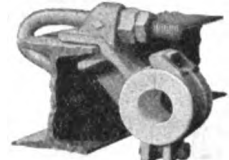
Style No.	Description	Wt., Lbs. Each	List Price
306852	12-foot arm with 3/8-inch x 8-foot, 9-inch tension rod.....	77	\$13 50
306805	End casting only.....	3.9	1 65

Tension rod and T-iron arm are regularly furnished painted black but can be furnished galvanized when so ordered at an increase in price.

## FEEDER TAP SUPPORT

750 Volts

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
119152	Support for I-beam or T-iron complete with spool.....	175	\$160 00



STYLE No. 119152

## MESSENGER INSULATORS TYPE J—3300 VOLTS

Style No.	Description	PER 100	
		Approx. Wt., Lbs.	List Price
<b>Complete</b>			
172929	Messenger insulator with japanned pin, complete.....	500	†
170051	Messenger insulator with sherardized pin, complete.....	500	†
<b>Parts</b>			
91466	Porcelain insulator only, for 500 to 3300 volts.....	250	†
172928	Insulator pin only, japanned.....	250	\$100 00
170052	Insulator pin only, sherardized.....	250	100 00



STYLE No. 170051

## TYPE JC—500 to 3300 Volts

Style No.	Description	PER 100	
		Approx. Wt., Lbs.	List Price
<b>Complete</b>			
92113	Main line insulator, complete, japanned pin.....	400	†
167815	Main line insulator, complete, sherardized pin.....	400	†
<b>Parts</b>			
91466	Porcelain insulator for Style Nos. 92113 and 167815.....	250	†
66131	Japanned insulator pin for Style No. 92113.....	230	\$100 00
167816	Sherardized insulator pin for Style No. 167815.....	200	100 00



STYLE Nos. 92113 and 167815

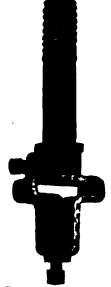
## TYPE LT INSULATOR PINS—500 to 11,000 Volts Sherardized

Style No.	Description	VOLTAGE		Dimensions		PER 100	
		Line	Dry Arcover	Wet Arcover	In Inches A B	Wt. Lbs.	List Price
305628	Insulator pin, sherardized...	500-3300	.....	.....	4 1/4 7 3/4	310	\$105 00
305629	Insulator pin, sherardized...	3300-11000	.....	.....	6 3/4 10 1/4	400	105 00
305650	Pin with insulator Style No. 91466.....	500-3300	40,000	20,000	4 1/2 5	585	†
305651	Pin with insulator Style No. 2-15.....	3300-6600	80,000	50,000	7 8 1/4	1000	†
305652	Pin with insulator Style No. 2-22.....	6600-11000	100,000	60,000	9 8 1/4	1500	†

†Prices on request.



STYLE No. 305628



STYLE No. 305629

## STEADY STRAINS

### TYPE AC—1500 and 3300 Volts

Style No.	Line Voltage	EACH	
		Wt., Lbs.	List Price
119658	1500	15	\$4 25
119659	3300	15	4 75

Style numbers do not include trolley clamp, but do include bracket arm clamp.

### TYPE AC-1—6600 Volts

92510	6600	15	\$7 00
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Style number does not include trolley clamp, but does include bracket arm clamp.

### TYPE AP—11,000 Volts

92512	11000	22	\$16 50
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### Parts

For Types AC, AC-1 and AP Steady Strains

Style No.	Description	EACH	
		Wt., Lbs.	List Price
49374	Steady-strain ear, 3/4-inch stud...	.8	\$ 84
92511	Bracket clamp for Style Nos. 92510, 119658 and 119659.....	5	2 00
68221*	Porcelain insulator for Style No. 92512.....	4.5	*
92513	Insulator bracket for Style No. 92512.....	8	5 75
88921	Strain insulator with end castings for Style Nos. 92510 and 92512.....	9	5 00

\*See Strain Insulator Section.



### STEADY STRAIN SUSPENSION—TYPE CB



Style No.	Description	Diameter Stud. Inches	PER 100	
			Wt. Lbs.	List Price
108963	Malleable iron, sherardized	3/8	92	\$42 00
108964	Malleable iron, sherardized	3/4	103	52 00
121602	Composition	3/8	82	80 00
121603	Composition	3/4	98	100 00

### STEADY STRAIN EAR—TYPE F



Style No.	Description	PER 100	
		Wt. Lbs.	List Price
49372	Malleable iron sherardized, with 1/2-inch tap	100	\$84 00
49374	Malleable iron sherardized, with 3/4-inch tap	95	84 00
49373	Composition, with 1/2-inch tap	110	170 00
49375	Composition, with 3/4-inch tap	105	170 00

### HANGERS



#### TYPE AB CROSS-SPAN MESSENGER HANGER

Style No.	Description	PER 100	
		Wt. Lbs.	List Price
165174	Malleable iron, sherardized	175	\$100 00

#### TYPE NF-1 CATENARY HANGER

For 00 to 0000 Grooved Trolley Wire

For Wheel and Pantagraph Trolley



Style No.	Length, Inches	PER 100		Style No.	Length, Inches	PER 100	
		Wt. Lbs.	List Price			Wt. Lbs.	List Price
248556	6	88	\$39 60	248572	14	112	\$44 40
248557	6 1/2	89 1/2	39 90	248573	14 1/2	113 1/2	44 70
248558	7	91	40 20	248574	15	115	45 00
248559	7 1/2	92 1/2	40 50	248575	15 1/2	116 1/2	45 30
248560	8	94	40 80	248576	16	118	45 60
248561	8 1/2	95 1/2	41 10	248577	16 1/2	119 1/2	45 90
248562	9	97	41 40	248578	17	121	46 20
248563	9 1/2	98 1/2	41 70	248579	17 1/2	122 1/2	46 50
248564	10	100	42 00	248580	18	124	46 80
248565	10 1/2	101 1/2	42 30	248581	18 1/2	125 1/2	47 10
248566	11	103	42 60	248582	19	127	47 40
248567	11 1/2	104 1/2	42 90	248583	19 1/2	128 1/2	47 70
248568	12	106	43 20	248584	20	130	48 00
248569	12 1/2	107 1/2	43 50	248585	20 1/2	131 1/2	48 30
248570	13	109	43 80	248586	21	133	48 60
248571	13 1/2	110 1/2	44 10				

#### TYPE CN PRESSED STEEL CATENARY HANGER

Galvanized

For 000 and 0000 Grooved Trolley Wire

Pantagraph Operation Only



Style No.	Length, Inches	PER 100		Style No.	Length, Inches	PER 100	
		Wt. Lbs.	List Price			Wt. Lbs.	List Price
305653	4	38	\$29 90	305671	13	51 1/2	\$32 55
305654	4 1/2	38 1/2	30 00	305672	13 1/2	52 1/4	32 75
305655	5	39 1/2	30 10	305673	14	53	32 90
305656	5 1/2	40 1/4	30 25	305674	14 1/2	53 1/4	33 00
305657	6	41	30 40	305675	15	54 1/2	33 15
305658	6 1/2	41 1/2	30 60	305676	15 1/2	55 1/4	33 30
305659	7	42 1/2	30 75	305677	16	56	33 40
305660	7 1/2	43 1/4	30 90	305678	16 1/2	56 1/2	33 50
305661	8	44	31 05	305679	17	57 1/2	33 65
305662	8 1/2	44 1/4	31 20	305680	17 1/2	58 1/4	33 80
305663	9	45 1/2	31 35	305681	18	59	33 90
305664	9 1/2	46 1/4	31 50	305682	18 1/2	59 1/4	34 00
305665	10	47	31 65	305683	19	60 1/2	34 10
305666	10 1/2	47 1/4	31 80	305684	19 1/2	61 1/4	34 25
305667	11	48 1/2	31 95	305685	20	62	34 35
305668	11 1/2	49 1/4	32 10	305686	20 1/2	62 1/4	34 50
305669	12	50	32 25	305687	21	63 1/2	34 65
305670	12 1/2	50 1/4	32 40				

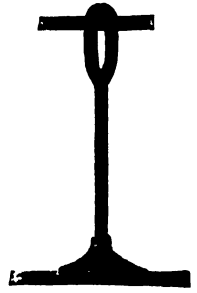
Order by Style Number



HANGERS—Continued

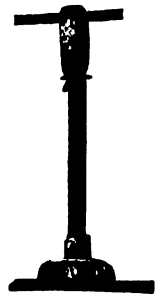
TYPE GF FLEXIBLE CATENARY HANGERS

STYLE No. For 000 Grooved	No. For 0000 Grooved	Length of Hanger, Inches	PER 100		STYLE No. For 000 Grooved	No. For 0000 Grooved	Length of Hanger, Inches	PER 100	
			Approx. Wt., Lbs.	List Price				Approx. Wt., Lbs.	List Price
193963	194050	6	89	\$61 50	193980	194067	14½	140	\$70 00
193964	194051	6½	92	62 00	193981	194068	15	143	70 50
193965	194052	7	95	62 50	193982	194069	15½	146	71 00
193966	194053	7½	98	63 00	193983	194070	16	149	71 50
193967	194054	8	101	63 50	193984	194071	16½	152	72 00
193968	194055	8½	104	64 00	193985	194072	17	155	72 50
193969	194056	9	107	64 50	193986	194073	17½	157	73 00
193970	194057	9½	110	65 00	193987	194074	18	160	73 50
193971	194058	10	113	65 50	193988	194075	18½	163	74 00
193972	194059	10½	116	66 00	193989	194076	19	166	74 50
193973	194060	11	119	66 50	193990	194077	19½	169	75 00
193974	194061	11½	122	67 00	193991	194078	20	172	75 50
193975	194062	12	125	67 50	193992	194079	20½	175	76 00
193976	194063	12½	128	68 00	193993	194080	21	178	76 50
193977	194064	13	131	68 50	193994	194081	21½	181	77 00
193978	194065	13½	134	69 00	193995	194082	22	184	77 50
193979	194066	14	137	69 50	247372	312530	Ear Only	32	45 00



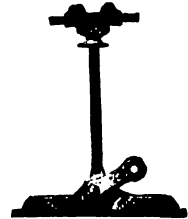
TYPE FS FLEXIBLE CATENARY HANGERS

Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price	Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price
175867	6	76	\$54 00	175883	14	102	\$58 80
175868	6½	77	54 30	175884	14½	104	59 10
175869	7	79	54 60	175885	15	106	59 40
175870	7½	81	54 90	175886	15½	108	59 70
175871	8	82	55 20	175887	16	109	60 00
175872	8½	84	55 50	175888	16½	111	60 30
175873	9	86	55 80	175889	17	112	60 60
175874	9½	87	56 10	175890	17½	114	60 90
175875	10	89	56 40	175891	18	116	61 20
175876	10½	91	56 70	175892	18½	117	61 50
175877	11	92	57 00	175893	19	119	61 80
175878	11½	94	57 30	175894	19½	121	62 10
175879	12	96	57 60	175895	20	122	62 40
175880	12½	98	57 90	175896	20½	124	62 70
175881	13	99	58 20	175897	21	126	63 00
175882	13½	101	58 50	.....	.....	.....	.....



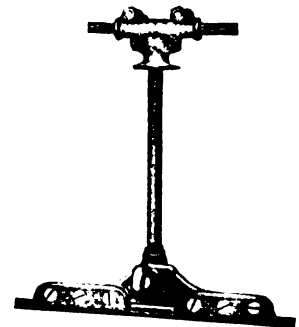
TYPE FC FLEXIBLE ANCHOR HANGERS

Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price	Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price
158837	6	305	\$182 50	158853	14	369	\$174 50
158838	6½	309	183 25	158854	14½	373	175 25
158839	7	313	184 00	158855	15	377	176 00
158840	7½	317	184 75	158856	15½	381	176 75
158841	8	321	185 50	158857	16	385	177 50
158842	8½	325	186 25	158858	16½	389	178 25
158843	9	329	187 00	158859	17	393	179 00
158844	9½	333	187 75	158860	17½	397	179 75
158845	10	337	188 50	158861	18	401	180 50
158846	10½	341	189 25	158862	18½	405	181 25
158847	11	345	190 00	158863	19	409	182 00
158848	11½	349	190 75	158864	19½	413	182 75
158849	12	353	191 50	158865	20	417	183 50
158850	12½	357	192 25	158866	20½	421	184 25
158851	13	361	193 00	158867	21	425	185 00
158852	13½	365	193 75	.....	.....	.....	.....



TYPE FC FLEXIBLE PULL-OFF HANGERS

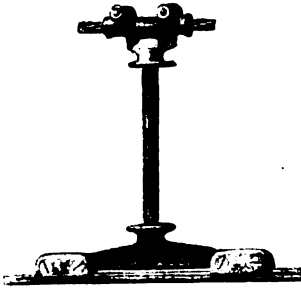
Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price	Style No.	Length of Hanger, Inches	PER 100 Approx. Wt., Lbs.	List Price
158872	6	251	\$182 50	158888	14	315	\$174 50
158873	6½	255	183 25	158889	14½	319	175 25
158874	7	259	184 00	158890	15	323	176 00
158875	7½	263	184 75	158891	15½	327	176 75
158876	8	267	185 50	158892	16	331	177 50
158877	8½	271	186 25	158893	16½	335	178 25
158878	9	275	187 00	158894	17	339	179 00
158879	9½	279	187 75	158895	17½	343	179 75
158880	10	283	188 50	158896	18	347	180 50
158881	10½	287	189 25	158897	18½	351	181 25
158882	11	291	190 00	158898	19	355	182 00
158883	11½	295	190 75	158899	19½	359	182 75
158884	12	299	191 50	158900	20	363	183 50
158885	12½	303	192 25	158901	20½	367	184 25
158886	13	307	193 00	158902	21	371	185 00
158887	13½	311	193 75	.....	.....	.....	.....



Order by Style Number

HANGERS—Continued

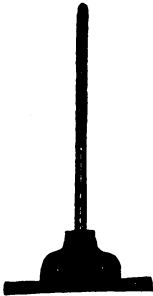
TYPE FL PULL-OFF HANGERS



Style No.	Length of Hanger, Inches	PER 100		Style No.	Length of Hanger, Inches	PER 100	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
176883	6	241	\$125 00	176899	14	305	\$137 00
176884	6½	245	125 75	176900	14½	309	137 75
176885	7	249	126 50	176901	15	313	138 50
176886	7½	253	127 25	176902	15½	317	139 25
176887	8	257	128 00	176903	16	321	140 00
176888	8½	261	128 75	176904	16½	325	140 75
176889	9	265	129 50	176905	17	329	141 50
176890	9½	269	130 25	176906	17½	333	142 25
176891	10	273	131 00	176907	18	337	143 00
176892	10½	277	131 75	176908	18½	341	143 75
176893	11	281	132 50	176909	19	345	144 50
176894	11½	285	133 25	176910	19½	349	145 25
176895	12	289	134 00	176911	20	353	146 00
176896	12½	293	134 75	176912	20½	357	146 75
176897	13	297	135 50	176913	21	361	147 50
176898	13½	301	136 25	.....	.....	.....	.....

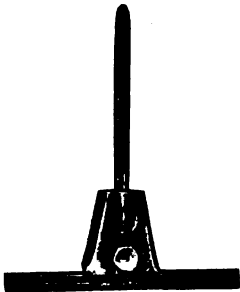
TYPE SK PRESSED STEEL HANGER  
Galvanized

For Wheel Trolley Operation Only



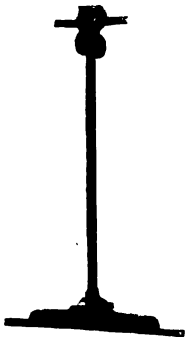
Style No.	Length of Hanger, Inches	PER 100		Style No.	Length of Hanger, Inches	PER 100	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
375030	4	44.25	\$54 70	375048	13	57.75	\$57 40
375031	4½	45.0	54 85	375049	13½	58.5	57 55
375032	5	45.75	55 00	375050	14	59.25	57 70
375033	5½	46.5	55 15	375051	14½	60.0	57 85
375034	6	47.25	55 30	375052	15	60.75	58 00
375035	6½	48.0	55 45	375053	15½	61.5	58 15
375036	7	48.75	55 60	375054	16	62.25	58 30
375037	7½	49.5	55 75	375055	16½	63.0	58 45
375038	8	50.25	55 90	375056	17	63.75	58 60
375039	8½	51.0	56 05	375057	17½	64.5	58 75
375040	9	51.75	56 20	375058	18	65.25	58 90
375041	9½	52.5	56 35	375059	18½	66.0	59 05
375042	10	53.25	56 50	375060	19	66.75	59 20
375043	10½	54.0	56 65	375061	19½	67.5	59 35
375044	11	54.75	56 80	375062	20	68.25	59 50
375045	11½	55.5	56 95	375063	20½	69.0	59 65
375046	12	56.25	57 10	375064	21	69.75	59 80
375047	12½	57.0	57 25				

TYPE CN PRESSED BRONZE HANGER



Style No.	Length of Hanger, Inches	PER 100		Style No.	Length of Hanger, Inches	PER 100	
		Approx. Wt., Lbs.	List Price			Approx. Wt., Lbs.	List Price
372256	4	41.75	\$55 20	372274	13	59.75	\$65 10
372257	4½	42.75	55 75	372275	13½	60.75	65 65
372258	5	43.75	56 30	372276	14	61.75	66 20
372259	5½	44.75	56 85	372277	14½	62.75	66 75
372260	6	45.75	57 40	372278	15	63.75	67 30
372261	6½	46.75	57 95	372279	15½	64.75	67 85
372262	7	47.75	58 50	372280	16	65.75	68 40
372263	7½	48.75	59 05	372281	16½	66.75	68 95
372264	8	49.75	59 60	372282	17	67.75	69 50
372265	8½	50.75	60 15	372283	17½	68.75	70 05
372266	9	51.75	60 70	372284	18	69.75	70 60
372267	9½	52.75	61 25	372285	18½	70.75	71 15
372268	10	53.75	61 80	372286	19	71.75	71 70
372269	10½	54.75	62 35	372287	19½	72.75	72 25
372270	11	55.75	62 90	372288	20	73.75	72 80
372271	11½	56.75	63 45	372289	20½	74.75	73 35
372272	12	57.75	64 00	372290	21	75.75	73 90
372273	12½	58.75	64 55				

TYPE FG CROSS-SPAN STEADY HANGERS

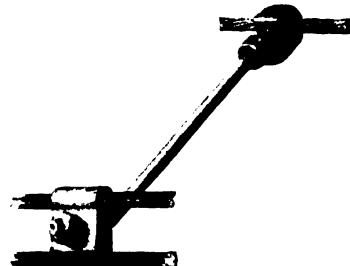


Style No.	Length of Hanger, Inches	PER 100	
		Approx. Wt., Lbs.	List Price
175931	22	425	\$270 00

TYPE WM CURVE HANGERS

(Patented)

For information on this hanger, write to the nearest district office.



TYPE WM HANGER

TYPE FG HANGER

Order by Style Number

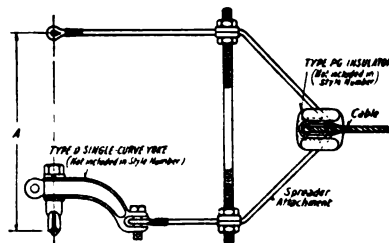
HANGERS—Continued

**TYPE SP CURVE PULL-OFF HANGERS**

For Wheel Trolley Operation Only

Spreader Attachment

Style No.	Dimension A	PER 100	
		Wt., Lbs.	List Price
176930	6 to 8	184	\$ 65 00
176931	8 to 10	200	70 00
176932	10 to 12	216	75 00
176933	12 to 14	232	80 00
176934	14 to 16	248	85 00
176935	16 to 18	264	90 00
176936	18 to 20	280	95 00
176937	20 to 22	296	100 00



**TYPE JR CATENARY PULL-OFF FOR PANTAGRAPH-TROLLEY OPERATION**

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
250293	Pull-off yoke only, japanned	500	\$130 00
250294	Pull-off yoke only, sherardized	500	143 00
268597	Pull-off yoke, complete with PP ear, japanned	575	172 00
268598	Pull-off yoke, complete with PP ear, sherardized	575	208 00



STYLES 268597-268598

**CLAMPS**

**TYPE FD INTERMEDIATE TWO-SCREW CLAMP**

Style No.	SIZE OF TROLLEY WIRE, B. & S. GAUGE		PER 100	
	Upper	Lower	Approx. Wt., Lbs.	List Price
162649	000 grooved	000 or 0000 grooved	50	\$42 00
149828	0000 grooved	000 or 0000 grooved	50	42 00



**TYPE CJ INTERMEDIATE CATENARY CLAMP**



Style No.	SIZE OF TROLLEY WIRE, B. & S. GAUGE		PER 100	
	Upper	Lower	Wt., Lbs.	List Price
193996	000 grooved	000 grooved	50	\$30 00
194084	0000 grooved	0000 grooved	50	30 00

**TYPE CA MESSENGER ANCHOR CLAMP**

Style No.	PER 100	
	Wt., Lbs.	List Price
163751	275	\$100 00



**TYPE EA ANCHOR CLAMP**



Style No.	Description	EACH	
		Wt., Lbs.	List Price
92141	Anchor clamp, sherardized	6	\$1 30

**TYPE DA MESSENGER ANCHOR CLAMP**

Style No.	EACH	
	Wt., Lbs.	List Price
165173	5	\$2 40



**TYPE JB ANCHOR EYE**

Style No.	EACH	
	Wt., Lbs.	List Price
123223	2	\$1 25



**TYPE KC INSULATED ADJUSTABLE CROSSING**

For 550 Volts D-C. and 6600 Volts A-C.



Style No.	Description	Length Overall Inches	Length of Insulation, Inches	EACH	
				Weight, Lbs.	List Price
176930	Type KC crossing, complete	85 1/2	70 1/2	30	\$65 00

Order by Style Number

**SECTION INSULATORS  
TYPE KB FOR WHEEL-TROLLEY OPERATION**

With Bronze End Castings

Style No.	Line Voltage	Size of Trolley Wire	Length Overall, Inches	Length of Side Rods, Inches	Length of Insulation, Inches	EACH	
						Wt., Lbs.	List Price
175933	750	000 groove	34 1/4	10 1/2	8	22	\$24 00
175934	750	0000 groove	34 1/4	10 1/2	8	22	24 00
175935	1500	000 groove	45 1/4	21 1/4	16	27	27 00
168165	1500	0000 groove	45 1/4	21 1/4	16	27	27 00



With Malleable Iron End Castings

241871	750	000 groove	34 1/4	10 1/2	8	22	20 00
241872	750	0000 groove	34 1/4	10 1/2	8	22	20 00
241873	1500	000 groove	45 1/4	21 1/4	16	27	22 00
241874	1500	0000 groove	45 1/4	21 1/4	16	27	22 00

**TYPE HC-2 FOR WHEEL-TROLLEY OR PANTAGRAPH OPERATION**

With Bronze End Castings

Style No.	Line Voltage	Size of Groove Trolley Wire	Length Overall, Inches	Length of Renewable Runner, Inches	EACH	
					Weight, Lbs.	List Price
185535	750	000	41	8	23	\$22 00
185536	750	0000	41	8	23	22 00
185594	1500	000	51	18	28	27 00
185595	1500	0000	51	18	28	27 00



With Malleable Iron End Castings

185592	750	000	41	8	23	18 00
185593	750	0000	41	8	23	18 00
185596	1500	000	51	18	28	23 00
185597	1500	0000	51	18	28	23 00

**ACCESSORIES FOR TYPES KB AND HC-2 SECTION INSULATORS**

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
185537	Hanger rod for 28-inch maximum to 16-inch minimum center of messenger to center of trolley wire at insulator.	192	\$162 50
91219	Cable clip for 1/4-inch and 1/2-inch diameter messenger cable.	20	25 00
185530	Cable clip for 5/8-inch diameter messenger cable.	25	25 00
102146	Cable clamp for 1/4-inch and 1/2-inch diameter cable.		See hardware section
102147	Cable clamp for 5/8-inch diameter cable.		See hardware section
184200	Renewable fibre runner (750 V) for HC-2 section insulator (two required).	See direct suspension sec.	
185550	Renewable fibre runner (1500V) for HC-2 section insulator (two required).	200	350 00
383418	Renewable mica runner (750 V) for KB section insulator.	See direct suspension sec.	
371952	Renewable mica runner (1500 V) for KB section insulator.	See direct suspension sec.	
383417	Renewable fibre runner (750 V) for KB section insulator.	See direct suspension sec.	
371951	Renewable fibre runner (1500 V) for KB section insulator.	See direct suspension sec.	
188425	Renewable approach for 000 groove trolley wire.	See direct suspension sec.	
188426	Renewable approach for 0000 groove trolley wire.	See direct suspension sec.	
187527	Chuck for 000 groove trolley wire.	See direct suspension sec.	
187529	Chuck for 0000 groove trolley wire.	See direct suspension sec.	

**TYPE HS-2 FOR PANTAGRAPH-TROLLEY OPERATION**



Style No.	Voltage	Length Overall, Inches	Insulation Distance, Inches	EACH	
				Weight, Lbs.	List Price
<b>With Gliders</b>					
197558	11000	106 1/2	72	41	\$45 00
197559	6600	82 1/2	48	36	42 50
197560	3300	61 1/2	30	32	40 00
<b>Without Gliders</b>					
*190318	11000	106 1/2	72	35	40 00
197145	6600	82 1/2	48	30	37 50
197144	3300	64 1/2	30	28	35 00

**TYPE HS-3 FOR PANTAGRAPH-TROLLEY OPERATION**



Style No.	Voltage	Length Overall, Inches	Insulation Distance, Inches	EACH	
				Weight, Lbs.	List Price
<b>With Gliders</b>					
197563	11000	102 1/2	72	37	\$37 50
*197564	6600	78 1/2	48	32	35 00
197565	3300	60 1/2	30	28	32 50
<b>Without Gliders</b>					
197561	11000	102 1/2	72	29	32 50
188897	6600	78 1/2	48	26	30 00
197562	3300	60 1/2	30	24	27 50

\*Styles No. 281850 and No. 281851, similar to styles No. 197564 and 190318 respectively, are special, and are made from gum-impregnated selected maple.

Order by Style Number

WOOD STRAIN INSULATORS

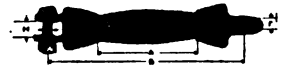
Style No.	DIMENSIONS, INCHES										Average — PER 100 — Break-Approx. Price				
	A	B	C	D	E	F	G	H	K	Test Load	ing Load	Wt., Lbs.	List Price		
<b>With Two Eyes at Right Angles</b>															
370936	2½	7½	¾	1	1	1	1	1	1	1	3500	7,000	134	\$68 00	
370937	2½	7½	¾	1	1	1	1	1	1	1	3500	7,000	166	78 00	
179475	5	9½	¾	1	1	1	1	1	1	1	5000	10,000	144	75 00	
179476	5	10	¾	1	1	1	1	1	1	1	5000	10,000	188	85 00	
179480	5	10½	¾	1	1	1	1	1	1	1	5000	10,000	195	85 00	
179488	5	13½	1	1½	1½	1	1	1	1	1	8000	16,000	500	180 00	
171794	12	16½	¾	1	1	1	1	1	1	1	3500	7,000	170	90 00	
179477	12	17	¾	1	1	1	1	1	1	1	5000	10,000	250	105 00	
179489	12	20½	1	1½	1½	1	1	1	1	1	8000	16,000	350	200 00	
179478	24	29	¾	1	1	1	1	1	1	1	5000	10,000	300	145 00	
179490	24	32½	1	1½	1½	1	1	1	1	1	8000	16,000	637	320 00	
179479	48	53	¾	1	1	1	1	1	1	1	5000	10,000	500	370 00	
179491	48	56½	1	1½	1½	1	1	1	1	1	8000	16,000	863	480 00	
<b>With Two Eyes in Same Plane</b>															
121730	5	9½	¾	1	1	1	1	1	1	1	3500	7,000	144	75 00	
121731	5	10	¾	1	1	1	1	1	1	1	5000	10,000	188	85 00	
157458	5	10½	¾	1	1	1	1	1	1	1	5000	10,000	188	85 00	
<b>With Eye and Clevis Parallel</b>															
121732	5	9½	¾	1	1	1	1	1	1	1	3500	7,000	154	90 00	
121733	5	10	¾	1	1	1	1	1	1	1	5000	10,000	232	100 00	
171072	12	16½	¾	1	1	1	1	1	1	1	3500	7,000	170	105 00	
121746	12	17	¾	1	1	1	1	1	1	1	5000	10,000	260	120 00	
121747	24	29	¾	1	1	1	1	1	1	1	5000	10,000	325	180 00	
<b>With Eye and Clevis at Right Angles</b>															
179481	5	9½	¾	1	1	1	1	1	1	1	3500	7,000	154	90 00	
179483	5	10	¾	1	1	1	1	1	1	1	5000	10,000	232	100 00	
179482	12	16½	¾	1	1	1	1	1	1	1	3500	7,000	170	105 00	
179484	12	17	¾	1	1	1	1	1	1	1	5000	10,000	260	120 00	
179485	24	29	¾	1	1	1	1	1	1	1	5000	10,000	325	180 00	
<b>With Eye and Tapped Boss</b>															
121734	5	9½	¾	1	1	1	1	1	1	1	¾-11	3500	7,000	141	95 00
123359	5	9½	¾	1	1	1	1	1	1	1	¾-11	5000	10,000	220	105 00
123360	5	9	¾	1	1	1	1	1	1	1	¾-10	5000	10,000	194	105 00
121738	12	16½	¾	1	1	1	1	1	1	1	¾-11	5000	10,000	241	125 00
121739	12	16½	¾	1	1	1	1	1	1	1	¾-10	5000	10,000	241	125 00
121740	24	28½	¾	1	1	1	1	1	1	1	¾-11	5000	10,000	288	165 00
121741	24	28½	¾	1	1	1	1	1	1	1	¾-10	5000	10,000	291	165 00
<b>With Two Clevises Parallel</b>															
125527	5	9½	...	...	1	...	...	¾	...	...	3500	7,000	200	105 00	
125529	5	10	...	...	1	...	...	¾	...	...	5000	10,000	253	115 00	
125531	12	17	...	...	1	...	...	¾	...	...	5000	10,000	273	135 00	
<b>With Clevis and Tapped Boss</b>															
125539	5	9½	...	...	1	...	...	¾	...	...	¾-11	3500	7,000	157	110 00
125541	5	9½	...	...	1	...	...	¾	...	...	¾-10	5000	10,000	235	120 00
125543	12	16½	...	...	1	...	...	¾	...	...	¾-10	5000	10,000	275	140 00
<b>With Two Tapped Bosses</b>															
125533	5	9½	...	...	1	...	...	¾	...	...	¾-11	3500	7,000	140	115 00
125535	5	9½	...	...	1	...	...	¾	...	...	¾-10	5000	10,000	194	125 00
125537	12	16½	...	...	1	...	...	¾	...	...	¾-10	5000	10,000	225	145 00



WITH TWO EYES AT RIGHT ANGLES



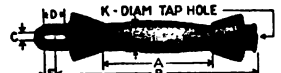
WITH TWO EYES IN THE SAME PLANE



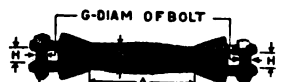
WITH ONE EYE AND ONE CLEVIS PARALLEL



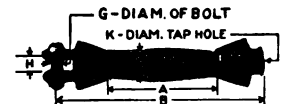
WITH ONE EYE AND ONE CLEVIS AT RIGHT ANGLES



WITH ONE EYE AND ONE TAPPED BOSS



WITH TWO CLEVISES PARALLEL



WITH ONE CLEVIS AND ONE TAPPED BOSS



WITH TWO TAPPED BOSSES

TYPE RC ADJUSTABLE WOOD STRAIN INSULATOR  
End Castings Sherardized  
With Two Eyes

Style No.	Description	Adjustment Inches	Wt., Lbs.	PER 100 List Price
128035	1½-inch diameter, 5 inches of insulation....	14 to 18	350	\$175 00
127124	1½-inch diameter, 12 inches of insulation....	21 to 25	530	200 00
157645	1½-inch diameter, 5 inches of insulation....	19½ to 23½	700	300 00

With Eye and Clevis

Style No.	Description	Adjustment Inches	Wt., Lbs.	PER 100 List Price
165093	1½-inch diameter, 5 inches of insulation	19½ to 23½	530	\$225 00

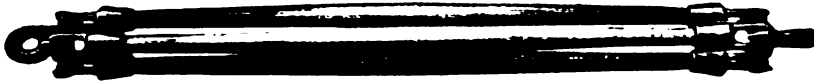


TYPE RC

Order by Style Number

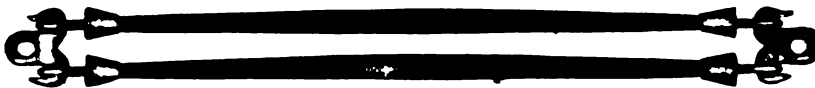
WOOD STRAIN INSULATORS—Continued

TRIPLE WOOD STRAIN INSULATORS  
Metal Parts Sherardized



Style No.	Description	Wt., Lbs. Each	List Price Each
158118	Hickory, oil impregnated	40	\$20 00
263546	Maple, gum impregnated	40	22 25

DOUBLE WOOD STRAIN INSULATORS  
Metal Parts Sherardized



Style No.	Description	Wt., Lbs. Each	List Price Each
202086	Hickory, oil impregnated	26	\$4 80
273438	Maple, gum impregnated	26	14 00

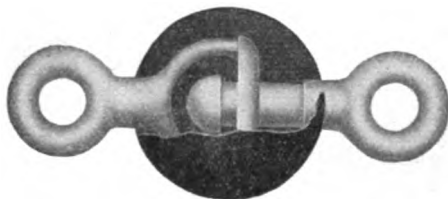
SINGLE WOOD STRAIN INSULATORS  
Metal Parts Sherardized



For use with double and triple insulators, part of Styles 158118, 216171, 263546 and 273438.

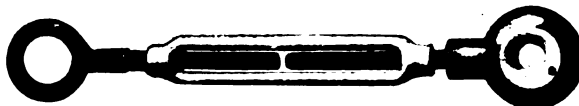
Style No.	Description	Wt., Lbs. EACH	List Price
202086	Hickory, oil impregnated, 1 1/2-inch diameter, 48 inches of insulation	9	\$4 80
263545	Maple, gum impregnated, 1 1/2-inch diameter, 48 inches of insulation	9	5 50

GLOBE STRAIN INSULATORS—600 VOLTS



Style No.	Description	Distance Between Centers of Eyes or Eye and Clevis	Wt., Lbs. PER 100	List Price
92146	2 -inch diameter—two 1/2-inch eyes	3 1/4	70	\$ 70 00
92147	2 1/2-inch diameter—two 3/8-inch eyes	4 1/2	105	90 00
97512	2 -inch diameter—with eye and clevis	5	100	85 00
97513	2 1/2-inch diameter—with eye and clevis	5 3/4	132	105 00

. TYPE TC INSULATED TURNBUCKLES



STYLE NOS.		DIMENSIONS INCHES			PER 100	
With Cylindrical Eye	With Oval Eye	Adjustment	Diameter Bolts	Distance Between Eye Centers When Contracted	Approx. Net Wt., Lbs.	List Price
120867	119919	6	1/2	13 1/4	220	\$220 00
126496	126524	6	5/8	13 1/2	260	270 00
126498	126526	9	1/2	15 1/2	260	230 00
126500	126528	9	5/8	15 3/4	365	280 00
120869	119921	12	5/8	18 1/2	410	295 00

Order by Style Number

## DURO MOLDED STRAIN INSULATORS

750 VOLTS D-C.

### With Two Eyes

Style No.	Diam. of Body Inches	Weight Lbs.	PER 100	
				List Price
311909	2	115		\$ 98 00
324081	2	120		108 00
324053	2 1/2	215		144 00
324058	2 1/2	220		154 00

### With Eye and Clevis

311911	2	125		108 00
324082	2	130		118 00
324055	2 1/2	240		184 00
324059	2 1/2	245		174 00

### With Two Clevises

324060	2	135		118 00
324057	2 1/2	250		184 00



## INSULATED FORK BOLTS



All metal parts are sherardized.

Style No.	Size Inches	Description	PER 100	
			Approximate Net Wt., Lbs.	List Price
138280	1/2x12	With porcelain spool	190	\$ 80 00
138282	3/4x12	With porcelain spool	255	95 00
138284	3/4x14	With porcelain spool	270	100 00

## BROOKLYN STRAIN INSULATORS

750 VOLTS

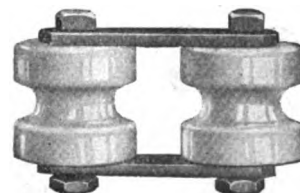
Style No.	Description	PER 100	
		Wt., Lbs.	List Price
281780	Standard size, sherardized	262	\$250 00
281781	Large size, sherardized	513	380 00



## SPOOL-TYPE STRAIN INSULATORS

600 VOLTS

Style No.	Description	PER 100	
		Wt., Lbs.	List Price
101942	With porcelain spools	125	\$100 00
127061	Porcelain spool only	33	10 00



Order by Style Number

## RAIL BONDS

### Ordering and Requesting Information

In ordering or requesting information on rail bonds the following data should be submitted:

1. Quantity desired.
2. Capacity of Bond
3. Diameter of Terminal
4. Length of Bond.

When giving length be sure to specify whether it is the straight and extended length or the formed length of the bond.

5. Type of Bond.

If a special type bond is desired give full dimensions and reference to some standard type.

### To Determine Lengths

The straight and extended length of a stud terminal bond is the distance from center to center of the terminals when straight and extended.

The formed length is the actual distance between the centers of terminals when formed for application to the rail.

For single conductor bonds having expansion crimps, add 1½ inches for each crimp to the formed length to get the net length or in other words the straight and extended length. The net length of solid and flexible conductor cross bonds is 2 inches longer than the formed length.

### TYPES OF RAIL BONDS

#### Concealed Rail Bonds



CROWN RAIL BOND  
TYPE C. S. 01 (SOLID TERMINALS)



CROWN RAIL BOND  
TYPE C. P. 01 (PIN TERMINALS)



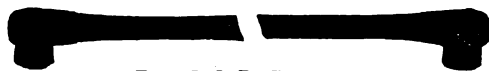
CROWN TRIPLEX RAIL BOND  
TYPE T. C. P. 1 (PIN TERMINALS)



UNITED STATES RAIL BOND  
TYPE U. S. 01 (SOLID TERMINALS)

These rail bonds, when factory-formed as illustrated, are priced according to their lengths, their terminal diameters, and their capacities. No addition in price is made for expansion crimps.

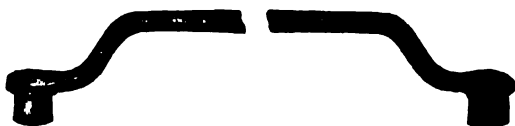
#### Exposed Crown Rail Bonds



TYPE C. S. F. (FLEXIBLE)  
Tubular terminals, Type C. P. F.



TYPE C. P. X.

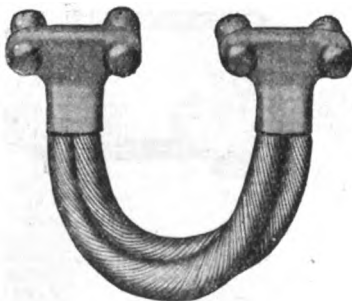


TYPE C. S. S. (SOLID)  
Tubular terminals, Type C. P. S.

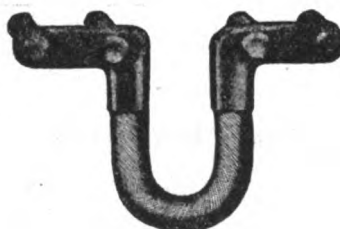
Solid Terminals, Type C. S. X.

These bonds are priced according to their straight and extended lengths, terminal diameters, and capacities.

#### Twin Terminal Bonds



STANDARD FORM A



FORM B TWIN STUD TERMINAL BOND

List prices for twin terminal bonds are based on the largest size terminal scheduled for bonds of equivalent capacity and correct length.



RAIL BONDS—Continued

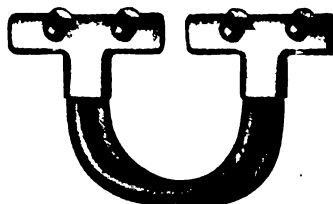
Soldered Rail Bonds



FORM 1. TYPE S. B., SOLDERED BOND



FORM C-2. TYPE B. S. B., SOLDERED STUD BOND



FORM A. TYPE B. S. B., SOLDERED STUD BOND



FORM U-1. TYPE B. S. B., SOLDERED STUD BOND

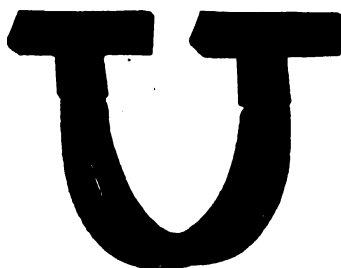
Prices and weights of these bonds are based upon the straight and extended lengths and desired capacities, using the smallest diameter terminals listed.

Flame Weld Bonds—All Copper

T-Head Terminal

Type FCA-2, Double Conductor

Type FCA-1, Single Conductor



TYPE FCA-2 DOUBLE CONDUCTOR

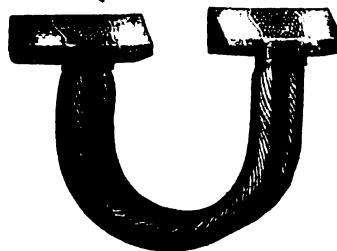
Flame Weld Bonds—Steel Terminals

T-Head Terminal

Type FSA-2, Double Conductor

Type FSA-1, Single Conductor

Type FUA, Flat Ribbon Conductor



TYPE FSA-2 DOUBLE CONDUCTOR

Prices and weights of these bonds are based upon the smallest terminal listed for the capacity of bond desired and upon the overall straight and extended length.

Arcweld Rail Bonds—Steel Welding Face

T-Head Terminals

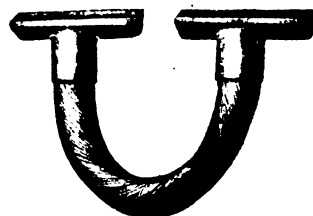
Type AA-1 Single Conductor—Type AA-2 Double Conductor

L-Head Terminals

Type A.B.-3—Type A.B.-4

Long Terminals

Type A.F.-1—Type A.S.-1—Type A.F.-2—Type A.S.-2

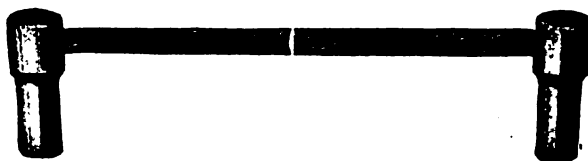


TYPE AA-1 SINGLE CONDUCTOR  
T-HEAD TERMINAL

Prices and weights are based upon the overall straight and extended lengths, and the smallest diameter terminals.

Mine Bonds—Type RM-1

Prices and weights are based on the distance between the centers of the terminals, the diameter of the terminals, and the capacities.



RAIL BONDS—Continued

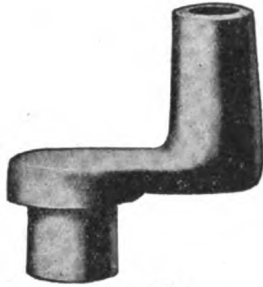
SOCKET TERMINALS



TYPE CSN



TYPE CPN



TYPE CSO



TYPE CPO

Standard List Prices per 100 Terminals

Diameter of Studs	1, 1/0 and 2/0		3/0 and 4/0		Over 250,000 C.M.		Over 350,000 C.M.		Over 450,000 C.M.		Over 550,000 C.M.		Over 650,000 C.M.		Over 750,000 C.M.	
	Am. Wire Gauge (B. & S.)	250,000 C.M.	Am. Wire Gauge (B. & S.)	350,000 C.M.	To 350,000 C.M.	To 450,000 C.M.	To 450,000 C.M.	To 550,000 C.M.	To 550,000 C.M.	To 650,000 C.M.	To 650,000 C.M.	To 750,000 C.M.	To 750,000 C.M.	To 750,000 C.M.	To 750,000 C.M.	
1/4 inch	\$20 00															
5/16 inch	25 00															
3/8 inch	30 00		\$37 50	\$37 50												
7/16 inch	35 00		42 50	42 50	\$50 00	\$55 00										
1 inch	40 00		47 50	47 50	55 00	60 00	\$75 00	\$85 00	\$100 00							

Drilling: When ordering above specify whether the shanks of the terminals are to be drilled for solid wire or strand.

BONDING TOOLS AND APPLIANCES

COMPRESSORS

Hand Screw Compressors



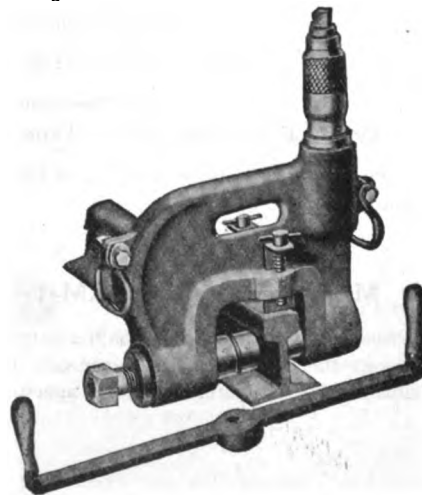
Trade No.	Approximate Weight, Pounds
38	28
40	65
42	80
44	105
46	140
48	165

Style and Size of Rail

Small mine rails up to 3 1/2-inch, 40 lbs., extreme 45 lbs.  
 T-rails up to 80 lbs., 5 1/4-inch and under  
 T-rail up to 6 1/4-inch  
 T and girder rails up to 7 1/4-inch  
 T and girder rails up to 9-inch  
 T and girder rails up to 9-inch—designed for rails having extra large head

Hydraulic Screw Compressors

Style No.	Trade No.	Style and Size of Rail	Weight Including Handle
305742	61	T-rail up to and including 120 pounds, 6 1/4 inches and under	115 lbs.
305743	063	Girder or T-rails, 7 1/2 inches and under	160 lbs.
305744	064	Girder and T-rails, to 9 inches.	190 lbs.
305745	68	Base of rail	58 lbs.



TYPE 61 HYDRAULIC SCREW COMPRESSOR

Order by Style Number

BONDING TOOLS AND APPLIANCES—Continued

NO. 3 BOYER ANGLE GEAR



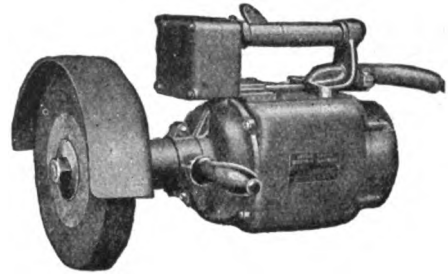
Style No.  
148130

Description  
No. 3 Boyer angle gear

EACH	
Weight, Lbs.	List Price
13	.....

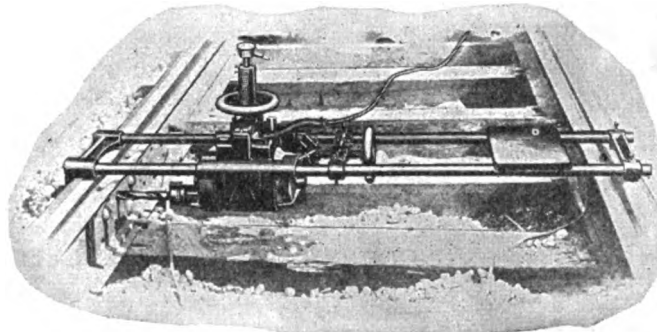
DUNTLEY PORTABLE ELECTRIC GRINDER

For 460 to 600-Volt D-C. Circuits



Style No.	Trade No.	Description	EACH	
			Net Wt., Lbs.	List Price
148189	8 B.P.	Duntley portable electric grinder	250 28	\$184 00
148189	8 B.P.	Duntley portable electric grinder	600 28	210 00

DUNTLEY ELECTRIC DRILL



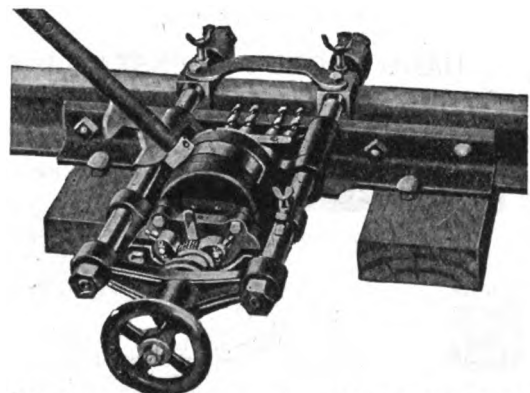
DUNTLEY ELECTRIC DRILL WITH ADJUSTABLE FRAME

Style No.	Trade No.	Voltage	Application	List Price Each
305746	2	250	For small mine rails and designed to drill holes up to 3/4 inch diameter.	\$520 00
		600		550 00
305747	3	250	For ordinary railway work and designed to drill holes up to 1 inch diameter.	650 00
		600		690 00
305748	4	600	For heavy duty and designed to drill holes up to 1 1/2 inches diameter.	830 00
		600		830 00

HAND-OPERATED DOUBLE-TWIN SPINDLE DRILL

Type No. 22

Style No.	Description	EACH	
		Net Wt., Lbs.	List Price
187193	Hand-operated double-twin-spindle drill, type No. 22	125	\$720 00



HAND-OPERATED DOUBLE-TWIN-SPINDLE-DRILL, TYPE NO. 22

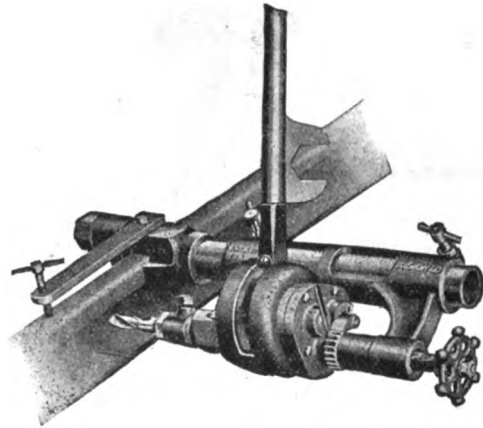
Order by Style Number

BONDING TOOLS AND APPLIANCES—Continued

HAND-OPERATED SINGLE-SPINDLE DRILL

Type No. 21

Style No.	Description	EACH	
		Net Wt., Lbs.	List Price
305749	Single-spindle drill, type No. 21...	100	\$520 00



SINGLE-SPINDLE DRILL, TYPE NO. 21

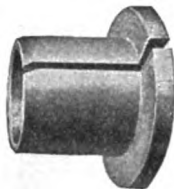
CHANNEL PINS



CHANNEL PIN

Style No.	Size Bonding Wire B. & S. Gauge	Outside Diam. Pin. Inches	Diam. Hole in Rail. Inches	PER 1000	
				Approx. Wt., Lbs.	List Price
135073	6	3/8	1/8	14	\$19 50
102247	4	3/8	1/8	15	19 50
135074	2	1/2	1/8	30	19 50
102248	0	1/2	3/8	32	25 00
181860	00	1/2	3/8	30	25 00
102249	00	1/2	3/8	50	25 00
186317	00	3/4	1/2	87	33 00
127101	000	3/4	1/2	85	33 00
102250	0000	1	1/2	80	33 00
186318	0000	1	3/8	110	52 00

COPPER BONDING SLEEVES



BONDING SLEEVE

Style No.	Size Bonding Wire B. & S. Gauge	Outside Diam. Cap Inches	Diam. Hole in Rail Inches	List Price Per 1000
135082	0	1/2	1/8	\$114 80
135083	0	1/2	3/8	134 00
135084	00	1/2	3/8	114 80
135085	00	1/2	3/8	134 00
135086	0000	1	3/8	165 80

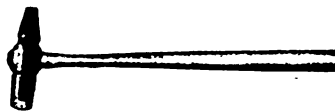
TOOLS FOR INSTALLING BONDING SLEEVES

Style No.	Description	List Price Each
137366	Drift punch	\$2 50
137367	Driving tool	2 50
137368	Upsetting tool	2 50

HAND TOOLS FOR INSTALLING TWIN-STUD TERMINAL BONDS

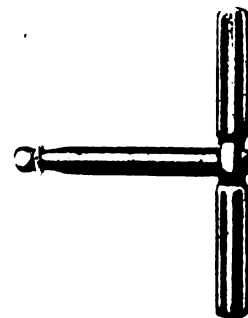


DULLING PUNCH. STYLE NO. 148137



RIVETING HAMMER. STYLE NO. 148138

Style No.	Description	Weight	List Price
148137	Dulling punch	3 oz.	\$ .60
148138	Riveting hammer	2 1/2 lbs.	2 00
255845	Milling cutter with handle	1/2 lb.	.90
255846	Old style groove cutter without handle	....	.50



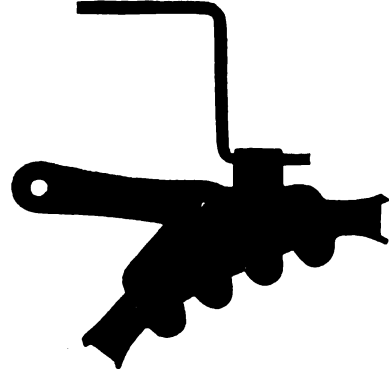
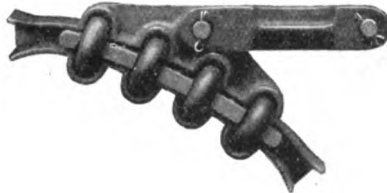
MILLING CUTTER  
STYLE NO. 255845

Order by Style Number

**SUSPENSION INSULATOR FITTINGS**

**SUSPENSION STRAIN CLAMPS—TYPE TB**

**Galvanized**



**Without Arcing Horns**

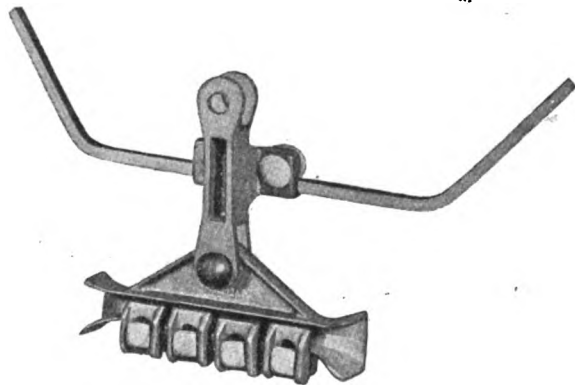
Style No.	DIAMETER OF CONDUCTOR		Diam. of Pin	Clevis Opening	PER 100	
	Min.	Max.			Weight Lbs.	List Price
<b>For Conductors up to and including 0000</b>						
247351	.25 inch	.50 inch	1/2 inch	1 1/2 inch	912	\$400 00
202036	.25 inch	.50 inch	3/8 inch	1 1/2 inch	914	400 00
<b>For Conductors from 0000 up to and including 300,000 cir. mils.</b>						
287547	.46 inch	.62 inch	1/2 inch	1 1/2 inch	1160	600 00
271881	.46 inch	.62 inch	5/8 inch	1 1/2 inch	1160	600 00
271880	.46 inch	.62 inch	3/4 inch	1 1/2 inch	1160	600 00

**With Arcing Horns**

Style No.	DIAMETER OF CONDUCTOR		Diam. of Pin	Clevis Opening	PER 100	
	Min.	Max.			Weight Lbs.	List Price
<b>For Conductors up to and including 0000</b>						
277957	.25 inch	.50 inch	5/8 inch	1 1/2 inch	1050	485 00
277958	.25 inch	.50 inch	1/2 inch	1 1/2 inch	1050	485 00
271882	Arcing Horn only				135	85 00
<b>For Conductors from 0000 up to and including 300,000 cir. mils.</b>						
281134	.46 inch	.62 inch	3/4 inch	1 1/2 inch	1295	685 00
281135	.46 inch	.62 inch	5/8 inch	1 1/2 inch	1295	685 00
268599	.46 inch	.62 inch	1/2 inch	1 1/2 inch	1295	685 00
271882	Arcing Horn only				135	85 00

**COMBINED SUSPENSION AND STRAIN CLAMP—TYPE TG**

**Galvanized**



**Without Arcing Horns**

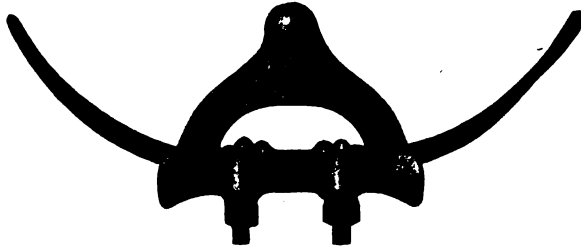
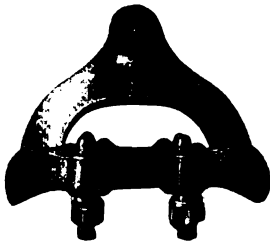
Style No.	DIAMETER OF CONDUCTOR		Diam. of Pin	Clevis Opening	PER 100	
	Min.	Max.			Weight Lbs.	List Price
371949	.2316 inch	.5738 inch	5/8 inch	3/4-inch	550	\$400 00
<b>With Arcing Horns</b>						
371950	.2316 inch	.5738 inch	5/8 inch	3/4-inch	650	475 00
372156	Arcing Horn only				100	75 00

Bolts and nuts used with these suspensions are sherardized; cotter pins are brass.

Order by Style Number

SUSPENSION INSULATOR FITTINGS—Continued

SUSPENSION WIRE CLAMPS—TYPE FR  
Galvanized



Without Arcing Horns

For Conductors from 0 to 0000

Style No.	DIAMETER OF CONDUCTOR		Diam. of Pin "A"	PER 100	
	Min.	Max.		Weight, Lbs.	List Price
287548	.37 inch	.52 inch	1/2 inch	300	\$240 00
287549	.37 inch	.52 inch	3/8 inch	300	240 00

For Conductors 0000 to 950,000 C.M.

287557	.46 inch	.62 inch	1/2 inch	400	295 00
287558	.46 inch	.62 inch	3/8 inch	400	295 00
374897	.625 inch	.875 inch	1/2 inch	550	350 00
374898	.625 inch	.875 inch	3/8 inch	550	350 00
374901	.875 inch	1.125 inch	1/2 inch	600	425 00
374902	.875 inch	1.125 inch	3/8 inch	600	425 00

With Arcing Horns

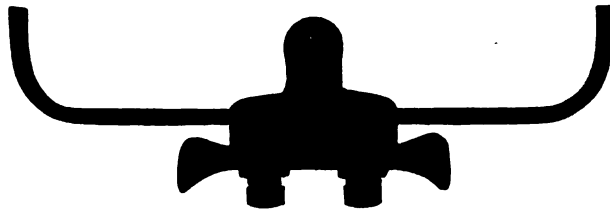
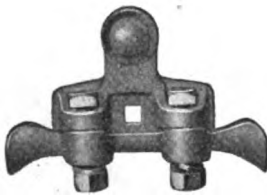
For Conductors 0 to 0000

281140	.37 inch	.52 inch	1/2 inch	350	270 00
281139	.37 inch	.52 inch	3/8 inch	350	270 00

For Conductors 0000 to 950,000 C.M.

273474	.46 inch	.62 inch	1/2 inch	450	320 00
273475	.46 inch	.62 inch	3/8 inch	450	320 00
374895	.625 inch	.875 inch	1/2 inch	650	380 00
374896	.625 inch	.875 inch	3/8 inch	650	380 00
374899	.875 inch	1.125 inch	1/2 inch	700	455 00
374900	.875 inch	1.125 inch	3/8 inch	700	455 00

SUSPENSION WIRE CLAMPS—TYPE AD  
Sherardized



For Conductors from 0 to 000, Inclusive

Without Arcing Horns

Style No.	DIAMETER OF CONDUCTOR		Diam. of Pin "A"	PER 100	
	Min.	Max.		Weight, Lbs.	List Price
251254	.37 inch	.46 inch	1/2 inch	300	\$175 00
184086	.37 inch	.46 inch	3/8 inch	300	175 00

With Arcing Horns

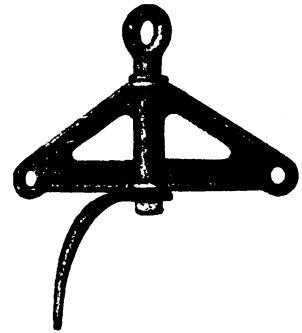
273472	.37 inch	.46 inch	1/2 inch	406	240 00
273473	.37 inch	.46 inch	3/8 inch	406	240 00

Order by Style Number

SUSPENSION INSULATOR FITTINGS—Continued

STRAIN YOKES—Type SK  
Galvanized

Style No.	Description	PER 100	
		Weight Lbs.	List Price
281138	Top Yoke with eye, with arcing horn.....	920	\$460 00
293694	Top Yoke with eye, without arcing horn.....	800	420 00
293689	Bottom Yoke with eye, with arcing horn, with 1/2 inch clevis links.....	1150	610 00
293690	Bottom Yoke with eye, with arcing horn, with 3/4 inch clevis links.....	1150	620 00
293696	Bottom Yoke with eye, without arcing horn, with 1/2 inch clevis links.....	1000	570 00
293697	Bottom Yoke with eye, without arcing horn, with 3/4 inch clevis links.....	1000	580 00



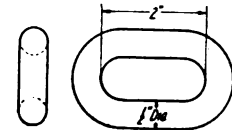
STYLE No. 281138



STYLE No. 286016 or 291964



STYLE No. 272537



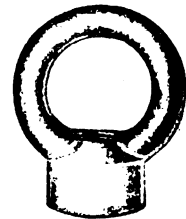
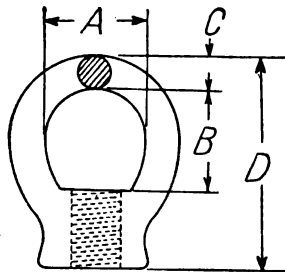
End to be welded  
STYLE No. 188857

Style No.	Description	PER 100	
		Weight Lbs.	List Price
286016	Clevis with 1/2 inch pin, galvanized.....	100	\$80 00
291964	Clevis with 3/8 inch pin, galvanized.....	100	80 00
272537	Drop forged hook, galvanized, heavy type.....	100	70 00
357242	Drop forged hook, galvanized, light type.....	80	50 00
188857	Welded suspension link, galvanized.....	35	10 00

DROP FORGED EYE NUTS  
Hot Galvanized



STYLE No. 372298



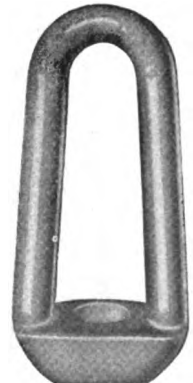
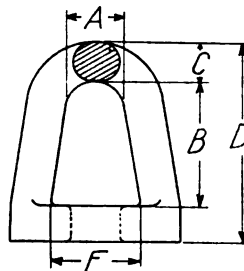
STYLE No. 372296

Style No.	Trade No.	Dia. Bolt Inches	A	B	C	D	PER 100	
							Wt. Lbs.	List Price
372294	7504	3/4	1 1/4	1 1/2	3/4	2 3/4	36	\$30 00
372295	7505	1/2	1 1/8	1 1/4	3/4	2 3/4	35	30 00
372296	7506	3/8	1 1/8	1 1/4	3/4	2 3/4	32	30 00
372297	7500	1/2	1 1/8	1 1/4	1/2	2 1/2	49	40 00
372298	7501	3/8	1 1/8	1 1/4	1/2	2 1/2	46	41 00
372299	7502	3/8	1 1/8	1 1/4	1/2	3 1/2	60	61 00
372300	7503	3/4	1 3/4	1 3/4	1/2	3 1/2	56	61 00

DROP FORGED BOLT EYES



STYLE No. 372301

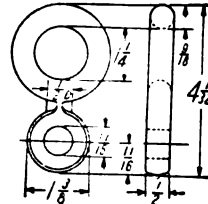
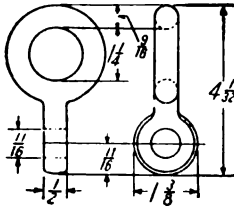


STYLE No. 372302

Style No.	Trade No.	Dia. Bolt In.	A	B	C	D	E	PER 100	
								Wt. Lbs.	List Price
372301	7514	3/4	1 3/4	1 3/4	1 1/2	2 1/2	1 1/4	75	\$47 00
372302	7515	3/4	1 3/4	3 1/4	1 1/2	4 1/2	1 3/4	125	47 00
372303	7516	3/4	1 3/4	3 1/4	1 1/2	4 1/2	1 3/4	120	47 00

## TRANSMISSION SUSPENSION LINK

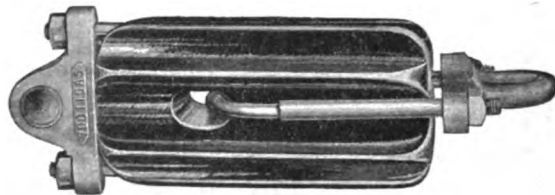
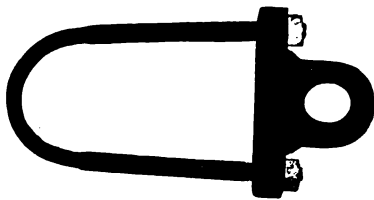
Galvanized



Style No.	Description	PER 100	
		Weight, Pounds	List Price
372002	Right angle twist link.....	60	\$38 00
372004	Flat figure 8 link.....	60	32 00
375885	Right angle twist link (high strength).....	100	49 00
675886	Flat figure 8 link (high strength).....	100	43 00

## TYPE PS INSULATOR CONNECTOR

Sherardized



Connector for Insulator No. 531

Style No.	Description	PER 100	
		Weight, Pounds	List Price
372552	U-bolt with two square nuts.....	36	\$30 00
372553	Eye casting, malleable iron.....	62 1/2	37 00
372554	Clevis casting, with pin, malleable iron.....	60	52 00

Connector for Insulator No. 532

358340	U-bolt with two square nuts.....	40	34 00
358341	Eye casting, malleable iron.....	60	44 00
358342	Clevis casting, with pin, malleable iron.....	50	52 00
358354	Tongs for assembling connectors.....	200	150 00

## GROUND WIRE BAYONETS

Hot Galvanized

Straight Bayonets

Style No.	Trade No.	Length, Inches	Size Angle, Inches	PER 100	
				Wt., Lbs.	List Price
252787	6436	36	2 x2 x 1/4	1000	\$55 00
252788	6448	48	2 1/2 x2 1/2 x 1/4	1640	82 00
252789	6466	66	2 1/2 x2 1/2 x 1/4	2255	102 00
252790	6484	84	3 x3 x 1/4	3430	137 00
<b>Corner Bayonets</b>					
252791	6536	36	2 x2 x 3/8	1370	82 00
252792	6548	48	2 x2 x 3/8	1825	105 00
252793	6566	66	2 x2 x 1/2	3350	173 00
252794	6584	84	2 1/2 x2 1/2 x 1/4	5500	254 00

### OFFSET BAYONETS FOR OVERHEAD GROUND WIRE

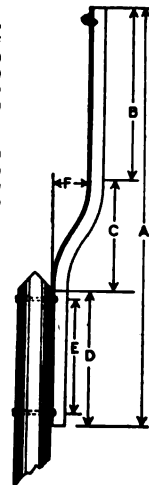
Hot Galvanized

Style No.	Trade No.	DIMENSIONS IN INCHES							PER 100	
		Lgth.	Size Angle	B	C	D	E	F	Wt., Lbs.	List Price
252795	6420	54	2 1/2 x2 1/2 x 1/4	24 1/2	12 1/2	17 1/2	15	7	1850	\$120 00
252796	6421	72	2 1/2 x2 1/2 x 1/4	40 1/2	12 1/2	19 1/2	17	7	2500	150 00
252797	6422	81	3 x3 x 1/4	34	21 1/2	26 1/2	22	7	3310	195 00

### BELCHER GROUND WIRE CLAMPS

Hot Galvanized

Style No.	Trade No.	Description	PER 100	
			Wt., Lbs.	List Price
214957	6450	Type J—attached with J-bolt	44	\$15 00
252788	6451	Type U—attached with U-bolt	70	24 00



Order by Style Number



## BO-ARROW ARMS

### SINGLE BO-ARROW ARMS

STYLE NO. FOR FORGED STEEL PIN		STYLE NO. FOR CLAMP PIN		DIMENSIONS IN INCHES		EACH	
Plain	Galvanized	Plain	Galvanized	Wire Spacing	Size Angle	Wt., Lbs.	List Price
214939	214944	214935	214943	24	2 1/4 x 2 1/4 x 1/4	21	\$2 20
252769	252770	252771	252772	30	2 1/2 x 2 1/2 x 1/4	25	2 28
214940	206606	214936	196342	36	3 x 3 x 1/4	39	3 59
214941	206607	214937	196343	52	3 x 3 x 1/4	52	4 31
214942	206608	214938	196344	72	3 x 3 x 1/4	69	5 82

### Straight Bayonets

STYLE No.		FOR BO-ARROW ARM	DIMENSIONS IN INCHES		EACH	
Plain	Galvanized	ARM	Length	Size Angle	Wt., Lbs.	List Price
214961	214962	24-inch spacing	32	2 x 2 x 1/4	8 1/2	\$0 87
252773	252774	30-inch spacing	40	2 x 2 x 1/4	10 1/2	94
214945	214948	36-inch spacing	50	2 1/4 x 2 1/4 x 1/4	17	1 56
214946	214949	52-inch spacing	66	2 1/4 x 2 1/4 x 1/4	22 1/2	1 87
214947	214950	72-inch spacing	75	3 x 3 x 1/4	31	2 53

### BO-ARROW DOUBLE ARMING SETS

FORGED STEEL PIN		STYLE NO.		CLAMP PIN		DIMENSIONS IN INCHES		PER SET	
Plain	Galvanized	Plain	Galvanized	Wire Spacing	Size Angle	Weight Lbs.	List Price		
252775	252780	253049	253054	24	2 1/4 x 2 1/4 x 1/4	43	\$ 4 54		
252776	252781	253050	253055	30	2 1/2 x 2 1/2 x 1/4	51	4 73		
252777	252782	253051	253056	36	3 x 3 x 1/4	113	10 40		
252778	252783	253052	253057	52	3 x 3 x 1/4	139	11 08		
252779	253048	253053	253058	72	3 x 3 x 1/4	173	13 65		

### Corner Bayonets

STYLE No.		FOR BO-ARROW ARM	DIMENSIONS IN INCHES		EACH	
Plain	Galvanized	ARM	Length	Size Angle	Wt., Lbs.	List Price
214963	214964	24-inch spacing	32	2 x 2 x 1/4	13	\$1 33
252784	252785	30-inch spacing	40	2 x 2 x 1/4	16	1 40
214951	214954	36-inch spacing	50	2 x 2 x 1/4	26	2 54
214952	214955	52-inch spacing	66	2 1/4 x 2 1/4 x 1/4	44	3 78
214953	214956	72-inch spacing	75	2 1/4 x 2 1/4 x 1/4	50	4 18

## INSULATOR PINS

### PEIRCE FORGED STEEL PINS

Hot Galvanized—With Drawn Zinc Separable Thimbles FOR WOOD ARMS

1500-Lb. Series for Insulators with 1-inch Bore

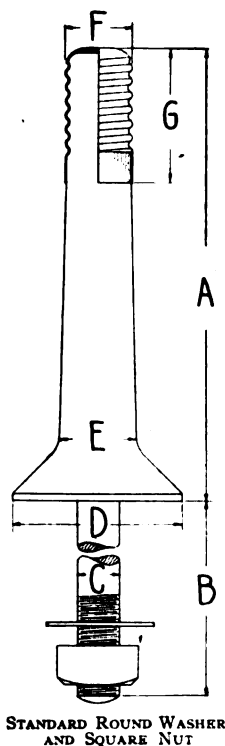
Style No.	Trade No.	DIMENSIONS IN INCHES					PER 100	
		A	B	C	D	E	F	G
249137	5102	3 1/2	5 1/2	3/4	2 1/4	.94	1 1/2	2
249138	5104	4	5 1/2	3/4	2 1/4	.98	1 1/2	2
249139	5106	4 1/2	5 1/2	3/4	2 1/4	1.02	1 1/2	2
249140	5108	5	5 1/2	3/4	2 1/4	1.05	1 1/2	2
249141	5110	5 1/2	5 1/2	3/4	2 1/4	1.08	1 1/2	2
249142	5112	6	5 1/2	3/4	2 1/4	1.12	1 1/2	2
249143	5114	7	5 1/2	3/4	3	1.15	1 1/2	2
249144	5116	8	5 1/2	3/4	3	1.22	1 1/2	2

1500-Lb. Series for Insulators with 1 1/8-inch Bore

249145	5118	4	6 1/2	3/4	2 1/2	1.16	1 1/2	2 1/2
249146	5120	5	6 1/2	3/4	2 1/2	1.20	1 1/2	2 1/2
249147	5122	5 1/2	6 1/2	3/4	2 1/2	1.22	1 1/2	2 1/2
249148	5124	6	6 1/2	3/4	2 1/2	1.23	1 1/2	2 1/2
249149	5126	7	6 1/2	3/4	3	1.26	1 1/2	2 1/2
249150	5128	8	6 1/2	3/4	3	1.30	1 1/2	2 1/2
252828	5130	9	6 1/2	3/4	3	1.33	1 1/2	2 1/2
252829	5132	10	6 1/2	3/4	3	1.36	1 1/2	2 1/2
252830	5134	11	6 1/2	3/4	3 1/2	1.38	1 1/2	2 1/2
252831	5136	12	6 1/2	3/4	3 1/2	1.41	1 1/2	2 1/2
252832	5138	13	6 1/2	3/4	3 1/2	1.44	1 1/2	2 1/2
252833	5140	14	6 1/2	3/4	3 1/2	1.48	1 1/2	2 1/2
252834	5142	15	6 1/2	3/4	3 1/2	1.51	1 1/2	2 1/2
252835	5144	16	6 1/2	3/4	3 1/2	1.58	1 1/2	2 1/2

3000-Lb. Series for Insulators with 1 3/8-inch Bore

252836	5146	4	8 1/2	1	2 1/2	1.26	1 1/2	2 1/2
252837	5148	5	8 1/2	1	2 1/2	1.30	1 1/2	2 1/2
252838	5150	5 1/2	8 1/2	1	2 1/2	1.35	1 1/2	2 1/2
252839	5152	6	8 1/2	1	2 1/2	1.37	1 1/2	2 1/2
252840	5154	7	8 1/2	1	3	1.41	1 1/2	2 1/2
252841	5156	8	8 1/2	1	3	1.47	1 1/2	2 1/2
252842	5158	9	8 1/2	1	3	1.53	1 1/2	2 1/2
252843	5160	10	8 1/2	1	3	1.57	1 1/2	2 1/2
252844	5162	11	8 1/2	1	3 1/2	1.63	1 1/2	2 1/2
252845	5164	12	8 1/2	1	3 1/2	1.68	1 1/2	2 1/2
252846	5166	13	8 1/2	1	3 1/2	1.74	1 1/2	2 1/2
252847	5168	14	8 1/2	1	3 1/2	1.80	1 1/2	2 1/2
252848	5170	15	8 1/2	1	3 1/2	1.86	1 1/2	2 1/2
252849	5172	16	8 1/2	1	3 1/2	1.92	1 1/2	2 1/2



Order by Style Number

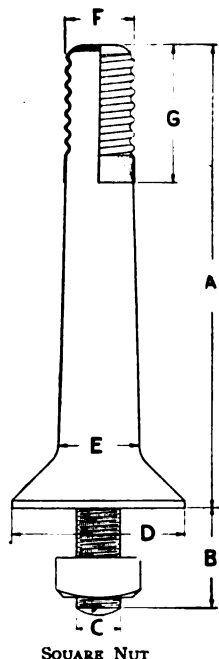
INSULATOR PINS—Continued

PEIRCE FORGED STEEL PINS—Continued

FOR STEEL ARMS

1500-Lb. Series for Insulators with 1-inch Bore

Style No.	Trade No.	DIMENSIONS IN INCHES							PER 100	
		A	B	C	D	E	F	G	Weight, Lbs.	List Price
249151	5101	3½	1¾	¾	2¼	.98	1½	2	158	\$22 50
249152	5103	4	1¾	¾	2¼	.98	1½	2	173	24 00
249153	5105	4½	1¾	¾	2¼	1.02	1½	2	188	25 50
249154	5107	5	1¾	¾	2¼	1.05	1½	2	202	27 00
249155	5109	5½	1¾	¾	2¼	1.08	1½	2	220	28 75
249156	5111	6	1¾	¾	2¼	1.12	1½	2	239	30 75
249157	5113	7	1¾	¾	3	1.15	1½	2	330	40 25
249158	5115	8	1¾	¾	3	1.22	1½	2	376	45 25



1500-Lb. Series for Insulators with 1¾-inch Bore

Style No.	Trade No.	A	B	C	D	E	F	G	Weight, Lbs.	List Price
249159	5117	4	1¾	¾	2½	1.17	1½	2½	215	28 25
249160	5119	5	1¾	¾	2½	1.20	1½	2½	247	31 50
249161	5121	5½	1¾	¾	2½	1.22	1½	2½	263	32 40
249162	5123	6	1¾	¾	2½	1.23	1½	2½	280	34 40
249163	5125	7	1¾	¾	3	1.26	1½	2½	346	43 35
249164	5127	8	1¾	¾	3	1.30	1½	2½	394	46 75
252864	5129	9	1¾	¾	3	1.33	1½	2½	444	51 40
252865	5131	10	1¾	¾	3	1.36	1½	2½	496	56 25
252866	5133	11	1¾	¾	3½	1.40	1½	2½	582	63 25
252867	5135	12	1¾	¾	3½	1.43	1½	2½	628	67 00
252868	5137	13	1¾	¾	3½	1.46	1½	2½	675	70 00
252869	5139	14	1¾	¾	3½	1.50	1½	2½	753	78 35
252870	5141	15	1¾	¾	3½	1.53	1½	2½	805	80 60
252871	5143	16	1¾	¾	3½	1.56	1½	2½	861	85 15

3000-Lb. Series for Insulators with 1¾-inch Bore

Style No.	Trade No.	A	B	C	D	E	F	G	Weight, Lbs.	List Price
252872	5145	4	2	1	2½	1.25	1½	2½	263	32 40
252873	5147	5	2	1	2½	1.30	1½	2½	300	37 00
252874	5149	5½	2	1	2½	1.33	1½	2½	340	41 25
252875	5151	6	2	1	2½	1.35	1½	2½	363	43 50
252876	5153	7	2	1	3	1.41	1½	2½	415	48 75
252877	5155	8	2	1	3	1.47	1½	2½	464	53 75
252878	5157	9	2	1	3	1.53	1½	2½	516	59 00
252879	5159	10	2	1	3	1.59	1½	2½	572	65 50
252880	5161	11	2	1	3½	1.65	1½	2½	702	75 00
252881	5163	12	2	1	3½	1.70	1½	2½	765	80 00
252882	5165	13	2	1	3½	1.76	1½	2½	837	85 75
252883	5167	14	2	1	3½	1.82	1½	2½	940	94 00
252884	5169	15	2	1	3½	1.88	1½	2½	1022	100 80
252885	5171	16	2	1	3½	1.94	1½	2½	1110	109 75

PRESTEEL CROSS-ARM SADDLES

Hot Galvanized



Style No.	Trade No.	Width of Cross Arm Inches	Size of Pin Hole Inches	PER 100	
				Wt., Lbs.	List Price
252800	5001	3½	¾	62	\$5 50
252801	5002	3½	¾	68	5 75
252802	5003	3¾	¾	74	6 00
252803	5004	4	¾	80	6 30
252804	5005	5	¾	100	7 70
252805	5011	3½	1	62	5 50
252806	5012	3½	1	68	5 75
252807	5013	3¾	1	74	6 00
252808	5014	4	1	80	6 30
252809	5015	5	1	100	7 70

PRESTEEL CENTERING WASHER

Hot Galvanized



Style No.	Trade No.	To Fit in Hole Diameter Inches	Size of Pin Hole Inches	PER 100	
				Weight, Lbs.	List Price
252810	5030	1¼	¾	12	\$1 60
252811	5031	1¼	1	12	1 60
252812	5032	1½	¾	13	1 70
252813	5033	1½	1	13	1 70

PEIRCE PRESTEEL POLE TOP BRACKETS

Hot Galvanized



Style No.	Trade No.	Diam. Pin Hole Inches	PER 100	
			Wt., Lbs.	List Price
305724	3035	1½	550	\$84 00
305725	3036	1¾	550	84 00

LEAD THREAD SEPARABLE THIMBLES FOR PEIRCE PINS

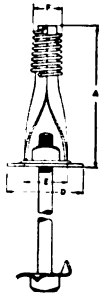
Style No.	Trade No.	Insulator Bore, Inches	Wt., Lbs. per 100	LIST PRICE PER 100	
				When Ordered Separately	When Ordered With Pins
305726	5020	1	25	\$14 00	\$9 00
305727	5025	1¾	40	15 00	10 00



Order by Style Number

INSULATOR PINS—Continued

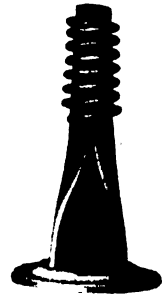
PEIRCE PRESTEEL PINS  
Hot Galvanized



FOR FLAT TOP ARMS		FOR ROUND TOP ARMS		INCHES				PER 100	
Style No.	Trade No.	Style No.	Trade No.	A	D	E	F	Wt., Lbs.	List Price
305728	5201	305733	5221	5	3	1 1/2	1	120	\$18 00
305729	5202	305734	5222	6 1/2	3 1/2	1 3/4	1	150	23 00
305730	5203	305735	5223	8	3 1/2	2	1	190	29 00
305731	5211	305736	5231	6 1/2	3 1/2	1 3/4	1 3/4	160	24 00
305732	5212	305737	5232	8	3 1/2	2	1 3/4	200	30 00

If you do not carry these sizes in stock, order bolts by the following stock numbers:

Style No.	Trade No.	Size in inches	PER 100
			Wt., Lbs. List Price
305738	5240	1/2 x 2 with nut	21 \$3 20
305739	5241	3/4 x 2 with nut	38 4 70
305740	5246	1/2 x 6 1/4 with washer and nut	49 6 00
305741	5247	3/8 x 6 1/4 with washer and nut	85 8 90



FLAT BASE FOR FLAT TOP ARMS

PEIRCE CLAMP PINS FOR HIGH-VOLTAGE INSULATORS ON STEEL AND WOOD CROSS-ARMS  
Hot Galvanized

1 7/8-inch Drawn Zinc Separable Thimble—1 3/8-inch Spring Thread



No. 252890 PIN WITH DRAWN THIMBLE

HEIGHT ABOVE ARM, INCHES		For		DRAWN ZINC THIMBLES			1 3/8-INCH SPRING THREADS		
Size Channel Inches	Angle Arms	Bo-Arrow and 3-inch Arms	For Wood 3 1/4 x 4 1/4 inches to 4 x 5 inches	PER 100		Style No.	PER 100		
				Weight, Lbs.	List Price		Weight, Lbs.	List Price	
1 x 1 1/2	6	3 3/4		172	\$22 00	252897	185	\$20 00	
1 x 1 1/2	7	4 3/4		187	23 00	252898	200	21 00	
1 x 1 1/2	8	5 3/4		203	24 00	252899	216	22 00	
1 x 1 1/2	9	6 3/4		217	27 00	252900	230	25 00	
1 x 1 1/2	10	7 3/4		230	30 00	252901	243	28 00	
1 x 1 1/2	11	8 3/4		244	32 00	252902	257	30 00	
1 x 1 1/2	12	9 3/4		257	35 00	252903	270	33 00	
1 x 1 1/2	13	10 3/4		270	37 00	252904	284	35 00	
1 1/4 x 1 1/2	14	11 3/4		322	40 00	252905	335	38 00	
1 1/4 x 1 1/2	15	12 3/4		338	43 00	252906	350	41 00	
1 1/4 x 1 1/2	16	13 3/4		352	46 00	252907	365	44 00	



No. 252901 PIN WITH SPRING THREAD

Clamping bolts are not included in pin prices.

PEIRCE CLAMPS FOR HIGH-VOLTAGE CLAMP PINS  
Hot Galvanized



STYLE No. 252914



STYLE No. 252916

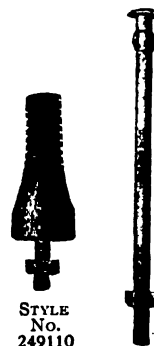


STYLE No. 252911

Style No.	Trade No.	Description	Size of Cross Arm, Inches	PER 100	
				Wt., Lbs.	List Price
252908	2001	Heavy cross-arm strap	3 1/4 x 4 1/4 Wood arm	142	\$12 00
252909	2002	Heavy cross-arm strap	3 1/2 x 4 1/2 Wood arm	148	12 75
252910	2003	Heavy cross-arm strap	3 3/4 x 4 3/4 Wood arm	154	13 50
252911	2004	Heavy cross-arm strap	4 x 5 Wood arm	160	14 25
252912	159	Angle clamp	2 1/2 x 2 1/2 Notched angle	90	5 75
252913	160	Angle clamp	3 x 2 Notched angle	90	5 75
252914	161	Angle clamp	3 x 3 Notched angle	100	6 00
252915	162	Angle clamp	3 1/2 x 3 1/2 Notched angle	115	6 50
252916	165	Pipe clamp	1 1/4 to 2 Standard pipe	160	10 00

WOOD TOP PINS WITH STEEL BOLTS  
Bolts Hot Galvanized or Plain

Style No.	Trade No.	SIZE OF WOOD TOP, INCHES			Size of Bolt, In.		Length of Bolt Below Top, In.	Wt., Lbs.	PER 100 List Price	
		Diam. Top	Diam. Bottom	Length	Diam.	Length			Untreated Oak	Paraffined Locust
249110	8070	1	1 1/2	4 1/2	1 1/2	5 1/2	52	\$24 40	\$27 80	
249111	8071	1	2 1/4	5 1/4	1 1/2	6 1/2	60	25 70	29 20	
249112	8072	1 3/8	2 1/4	4 1/2	1 1/2	5 1/2	90	29 40	33 30	
249113	8073	1 3/8	2 1/4	5 1/4	1 1/2	6 1/2	115	31 40	35 52	
249114	8074	1	1 1/2	4 1/2	1 1/2	9 1/2	5	27 08	30 60	
249115	8075	1	2 1/4	5 1/4	1 1/2	10 1/2	5 1/4	28 88	32 60	
249116	8076	1	2 1/4	5 1/4	1 1/2	11 1/2	6 1/4	29 50	33 40	
249117	8077	1 3/8	2 1/4	4 1/2	1 1/2	9 1/2	5	34 40	39 00	
249118	8078	1 3/8	2 1/4	4 1/2	1 1/2	10 1/2	6	37 00	42 00	
249119	8079	1 3/8	2 1/4	5 1/4	1 1/2	10 1/2	5 1/4	38 50	43 70	
249120	8080	1 3/8	2 1/4	6 1/2	1 1/2	12 1/2	6	44 40	48 84	
249121	8081	1 3/8	2 1/4	8	1 1/2	14	6	48 80	60 60	
249122	8082	1 3/8	2 1/4	9	1 1/2	16	7	55 50	65 20	



STYLE No. 249110

Order by Style Number

INSULATOR PINS—Continued

STANDARD WESTERN UNION PINS

Hot Galvanized



Style No.	Trade No.	Diam., Bolt Inches	LENGTH, INCHES		Weight, Lbs.	PER 100	List Price
			Above Shoulder	Below Shoulder			
252930	8000	1 1/2	4 1/4	5	73		\$14 04
252931	8005	1 1/2	4 3/4	5	110		21 43

Regularly furnished Hot Galvanized, but can be furnished plain when so ordered.

SHORT SHANK WESTERN UNION PINS  
Hot Galvanized or Plain

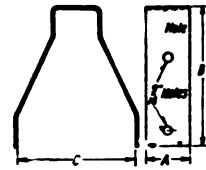


Style No.	Trade No.	Diam., Bolt Inches	LENGTH, INCHES		Weight, Lbs.	PER 100	List Price
			Above Shoulder	Below Shoulder			
252932	8010	1 1/2	4	1	48		\$15 70
252933	8015	1 1/2	4	1	65		23 00

POLE-TOP RIDGE IRON

STYLE No.	STYLE No.
252930	252932
198222	9407
198223	9408

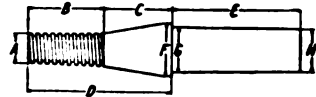
Style No.	Trade No.	DIMENSIONS, INCHES			Diam. Pin Hole, In.	Strap Iron	Approx. Net Wt., Lbs.	PER 100	List Price
		A	B	C					
198222	9407	2 1/4	7	6	3/8	1/2 x 2 1/2	135	\$39 88	
198223	9408	2 3/4	8	7	3/8	1/2 x 2 3/4	285	51 74	



POLE-TOP RIDGE IRON

LOCUST WOOD PINS

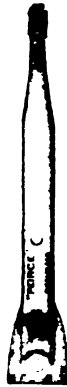
Style No.	DIMENSIONS, INCHES						Diam. Pin Hole, In.	Strap Iron	Approx. Net Wt., Lbs.	PER 100	List Price
	A	B	C	D	E	F					
102121	1	2 1/4	2 1/4	4 1/4	4 1/4	1 1/4	1 1/2	1 1/2	45	\$4 00	
102125	1 1/2	2 1/4	2 3/4	4 1/4	4 1/4	1 1/4	1 1/2	1 1/2	45	4 75	



LOCUST PIN

POLE TOP PINS

Hot Galvanized  
Pipe Pins



PIPE PINS

PRESTEEL PIN

Style No.	Trade No.	DIMENSIONS IN INCHES		Style of Top	PER 100	List Price
		Size Steel	Spacing Between Holes			
252934	3050	1 1/4	18	8 1 1/4-inch Spring Th.	336	\$ 80 00
252935	3052	1 1/4	24	8 1 1/8-inch Spring Th.	448	78 00
252936	3054	1 1/4	36	10 1 1/2-inch Spring Th.	672	107 00
252937	3060	1 1/4	18	8 1 1/2-inch Thimble	336	65 00
249108	3062	1 1/4	24	8 1 1/2-inch Thimble	448	81 00
252939	3064	1 1/4	36	10 1 1/2-inch Thimble	672	112 00

Presteeel Pins

Style No.	Trade No.	DIMENSIONS IN INCHES		Style of Top	PER 100	List Price
		Length	Spacing Between Holes			
252940	3040	18	8	1 -inch Spring Thread	227	\$45 00
252941	3041	18	8	1 1/8-inch Spring Thread	230	45 00
252942	3042	18	8	1 1/4-inch Thimble	227	50 00
252943	3043	18	8	1 1/2-inch Thimble	230	50 00
252944	3045	24	8	1 -inch Spring Thread	303	61 00
252945	3046	24	8	1 1/8-inch Spring Thread	305	61 00
252946	3047	24	8	1 1/4-inch Thimble	303	66 00
249109	3048	24	8	1 1/2-inch Thimble	305	66 00

TURNBUCKLES  
Galvanized



TYPE A, EYE AND EYE



TYPE B, EYE AND HOOK



TYPE C, EYE AND CLEVIS

Style No.	Diameter of Bolts Inches	Length of Opening Inches	Weight, Lbs.	PER 100	List Price
253037	1/2	6	175	150 00	
253038	1 1/2	9	190	200 00	
253039	1 1/2	12	230	250 00	
253040	1 1/2	6	270	210 00	
253041	1 1/2	9	335	250 00	
253042	1 1/2	12	400	300 00	
253043	1 1/2	6	400	285 00	
253044	1 1/2	9	505	325 00	
253045	1 1/2	12	610	400 00	

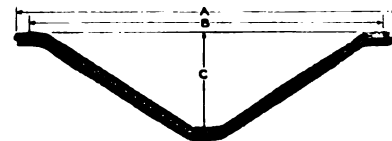
Can be furnished plain. When ordering specify type letter.

Order by Style Number

## MISCELLANEOUS HARDWARE

### ANGLE CROSS ARM BRACES

Style No.	Trade No.	Size Angle	DIMENSIONS IN INCHES			PER 100	
			A	B	C	Wt., Lbs.	List Price
252740	7950	1 1/2 x 1 1/2 x 3/8	40	37	12	720	\$105 26
196081	7951	1 1/2 x 1 1/2 x 3/8	45	42	12	780	110 14
196082	7952	1 1/2 x 1 1/2 x 3/8	51	48	14 1/4	885	122 48
196083	7953	1 1/2 x 1 1/2 x 3/8	63	60	18	1295	171 96
196084	7954	1 1/2 x 1 1/2 x 3/8	69	66	20	1365	180 82
252741	7955	1 3/4 x 1 1/2 x 3/8	75	72	18	1450	192 32
196085	7956	2 x 2 x 3/8	75	72	22	1830	226 60



ANGLE STEEL CROSS-ARM BRACE  
SHOWING METHOD OF MEASURING

### N. E. L. A. STANDARD ANGLE CROSS-ARM BRACES

Style No.	Trade No.	Size Angle	DIMENSIONS IN INCHES		PER 100	List Price
			B	C		
370938	7940	1 1/2 x 1 1/2 x 3/8	42	12	700	\$110 76
370939	7941	1 1/2 x 1 1/2 x 3/8	48	18	950	150 12
370940	7942	1 1/2 x 1 1/2 x 3/8	60	18	1120	163 14
370941	7943	1 1/2 x 1 1/2 x 3/8	72	22	1340	188 44

These braces have two 1/4-inch holes and one 3/8-inch hole.

### STANDARD CROSS-ARM BRACES

Style No.	Size, Inches	PER 100 Approx.		Style No.	Size, Inches	PER 100 Approx.	
		Net Wt., Lbs.	List Price			Net Wt., Lbs.	List Price
102259	20x1 x 3/8	100	\$12 12	102289	24x1 1/4 x 1/4	200	\$20 26
102273	20x1 1/2 x 1/2	142	14 38	102276	26x1 1/2 x 1/2	184	18 64
102287	20x1 1/4 x 1/4	167	16 92	102290	26x1 1/4 x 1/4	216	21 92
102260	22x1 x 3/8	110	13 34	102277	28x1 1/2 x 1/2	198	20 04
102274	22x1 1/2 x 1/2	156	15 80	102291	28x1 1/4 x 1/4	233	23 66
102285	22x1 1/4 x 1/4	183	18 58	102278	30x1 1/2 x 1/2	212	21 46
102261	24x1 x 3/8	120	14 56	102292	30x1 1/4 x 1/4	250	25 32
102275	24x1 1/2 x 1/2	170	17 22				



CROSS-ARM BRACE

### "BULL-DOG" WIRE ROPE CLAMPS

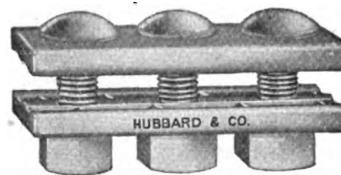
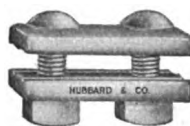
Malleable Iron Clamp. Steel Bolt. Hot Galvanized

Style No.	Size of Strand, Inches	Approx. Net Wt., Lbs.	PER 100	List Price
102144	3/8	21		8 60
102145	1/2	33		10 50
102146	3/4	69		15 00
102147	7/8	82		20 25
102148	1	120		27 75



### STANDARD ROLLED STEEL GUY CLAMPS

Hot Galvanized



Style No.	Trade No.	Description	Size of Strand, Inches	Length of Clamp, Inches	PER 100	
					Approx. Net Wt., Lbs.	List Price
130582	7448	Two-bolt clamp	1/4 to 3/4	3	115	\$27 12
130583	7449	Three-bolt clamp	1/4 to 3/4	4	185	37 14
215891	7450	Three-bolt clamp	1/4 to 1/2	6	210	43 46
370942	7460	Three-bolt clamp (heavy)	1/4 to 1/2	6	370	90 74

### SCHAPER FORGED GUY CLAMPS

Hot Galvanized

Style No.	Trade No.	PER 100	
		Wt., Lbs.	List Price
252743	7465	210	\$77 76



Order by Style Number

MISCELLANEOUS HARDWARE—Continued

THROUGH BOLTS



Style No.	Size, In.	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, In.	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, In.	Approx. Net Wt., Lbs. Per 100	List Price Per 100
137231	1/2x10	65	\$10 12	137242	5/8x10	105	\$14 66	196637	3/4x10	157	\$21 30
137232	1/2x11	71	10 76	137243	5/8x11	113	15 62	196638	3/4x11	169	22 68
137233	1/2x12	76	11 40	137244	5/8x12	121	16 56	196639	3/4x12	181	24 06
137234	1/2x13	82	12 12	137245	5/8x13	130	17 40	196640	3/4x13	193	25 42
137235	1/2x14	87	12 76	137246	5/8x14	138	18 46	196641	3/4x14	205	26 80
137236	1/2x15	93	13 15	137247	5/8x15	146	19 42	196642	3/4x15	216	28 07
137237	1/2x16	98	14 04	137248	5/8x16	155	20 36	196643	3/4x16	228	29 44
137238	1/2x17	104	14 93	137249	5/8x17	163	21 42	196644	3/4x17	240	30 81
137239	1/2x18	109	15 82	137250	5/8x18	171	22 36	196645	3/4x18	252	32 18
137240	1/2x19	115	16 71	137251	5/8x19	180	23 28	196646	3/4x20	275	34 82
137241	1/2x20	120	17 60	137252	5/8x20	188	24 26				

STANDARD MACHINE BOLTS

With Square Heads and Hot-Pressed Square Nuts



Style No.	Size, In.	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, In.	Approx. Net Wt., Lbs. Per 100	List Price Per 100
196713	3/8x4	16.5	\$3 84	136868	3/4x10	65.0	\$10 12
136849	3/8x4 1/2	18.0	4 06	136872	3/4x 8	88.2	12 66
136850	3/8x5	19.5	4 26	136873	3/4x 9	96.5	13 72
136851	3/8x5 1/2	21.0	4 47	136874	3/4x10	104.8	14 66
136852	3/8x6	22.5	4 68	136875	3/4x11	113.1	15 62
136858	1/2x4	32.8	6 13	136876	3/4x12	121.4	16 56
136859	1/2x4 1/2	35.4	6 20	136878	3/4x 8	131.6	18 54
136860	1/2x5	38.1	6 71	136879	3/4x 9	143.8	19 92
136861	1/2x5 1/2	40.7	7 05	136880	3/4x10	156.0	21 30
136862	1/2x 6	43.4	7 38	136881	3/4x11	168.2	22 68
136863	1/2x 6 1/2	46.0	7 72	136882	3/4x12	180.4	24 06
136864	1/2x 7	48.7	8 12	136883	3/4x13	192.6	25 42
136866	1/2x 8	54.0	8 76	136884	3/4x14	204.8	26 80
136867	1/2x 9	59.5	9 38				

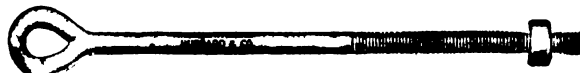
SPACING BOLTS



Style No.	Size, Inches	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, Inches	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, Inches	Approx. Net Wt., Lbs. Per 100	List Price Per 100
196802	1/2x12	71	\$17 72	196803	5/8x12	143	\$27 00	196804	3/4x12	225	\$40 08
196805	1/2x13	85	18 42	196806	5/8x13	150	28 05	196807	3/4x14	249	43 14
196808	1/2x14	89	19 10	196809	5/8x14	158	29 12	196810	3/4x15	260	44 62
196811	1/2x15	93	19 84	196812	5/8x15	165	30 18	196813	3/4x16	272	46 14
196814	1/2x16	97	20 58	196815	5/8x16	173	31 22	196816	3/4x17	283	47 66
196817	1/2x17	100	21 28	196818	5/8x17	180	32 38	196819	3/4x18	295	49 26
196820	1/2x18	104	21 92	196821	5/8x18	188	33 44	196822	3/4x20	318	52 32
196823	1/2x20	112	23 94	196824	5/8x20	202	35 56	196825	3/4x22	341	55 28
196826	1/2x22	120	25 34	196827	5/8x22	216	37 66	196828	3/4x24	364	58 28

DROP FORGED EYE BOLTS

With Nut and Washer



Style No.	DIMENSIONS, INCHES			Approx. Net Wt., Lbs.		List Price Per 100	Style No.	DIMENSIONS, INCHES			Approx. Net Wt., Lbs.		List Price Per 100
	Diameter Bolt	Length	Thread	Per 100	Per 100			Diameter Bolt	Length	Thread	Per 100	Per 100	
83393	3/8	5	3 1/2	35	\$23 20	101957	5/8	10	6	128	\$32 80		
136898	1/2	6	4	56	24 04	101958	5/8	12	6	144	35 32		
136818	3/8	7	5	62	24 65	101959	5/8	14	6	160	37 74		
101953	1/2	10	6	77	27 44	101960	5/8	16	6	177	40 60		
101954	1/2	12	6	87	29 14	196717	5/8	12	6	214	47 26		
101955	1/2	14	6	97	30 84	196718	5/8	14	6	238	50 64		
101956	1/2	16	6	107	32 54	196719	5/8	16	6	262	54 12		
136817	5/8	8	6	111	30 48	196720	5/8	18	6	268	57 50		

CARRIAGE BOLTS



Style No.	Size, Inches	Approx. Net Wt., Lbs. Per 100	List Price Per 100	Style No.	Size, Inches	Approx. Net Wt., Lbs. Per 100	List Price Per 100
137268	3/4x2 1/2	12	\$2 72	137275	1 1/4x4	30	\$5 48
196714	3/4x3	13	2 94	196715	1 1/4x4 1/2	33	5 86
137268	3/4x3 1/2	14	3 16	137278	1 1/4x5	35	6 20
137270	3/4x4	16	3 38	196718	1 1/4x5 1/2	38	6 56
137272	3/4x4 1/2	18	3 58	137277	1 1/4x6	40	6 80
137273	3/4x5	19	3 80				

All bolts on this page are hot galvanized.

Order by Style Number

MISCELLANEOUS HARDWARE—Continued

**STANDARD LAG SCREWS**  
Hot Galvanized



Style No.	Size Inches	Approx. Net		Style No.	Size Inches	Approx. Net	
		Wt. Lbs. Per 100	List Price Per 100			Wt. Lbs. Per 100	List Price Per 100
196721	5/8x2	8	\$3 18	137300	1/2x3	20	\$4 96
196722	5/8x2 1/4	9	3 44	137301	1/2x3 1/2	22	5 38
137294	5/8x3	10	3 70	137302	1/2x4	24	5 70
137295	5/8x3 1/2	11	3 90	137303	1/2x4 1/2	26	6 12
137296	5/8x4	12	4 22	137304	1/2x5	29	6 64
196723	5/8x4 1/2	13	4 44	137306	1/2x6	34	7 80
196724	5/8x5	14	4 74	137307	1/2x7	39	9 28
				137309	1/2x8	44	10 76

Furnished fetter drive unless otherwise specified.

**WASHERS**

**Positive Lock Washers**



Style No.	Bolt Fit	DIMENSIONS, INCHES			Approx. Net Wt., Lbs. Per 1000	List Price Per 100
		Diameter Hole	Outside Diameter	Thickness		
137372	1/8	1/8	1/8	1/8	12	\$1 00
137373	1/8	1/8	1/8	3/16	22	1 20
137374	1/8	1/8	1/8	1/4	35	1 25
137375	1/8	1/8	1/8	5/16	63	1 50
137376	1/8	1/8	1/8	3/4	83	1 70
137377	1	1 1/2	1 1/2	1 1/2	111	2 25

Furnished sherardized unless otherwise ordered.

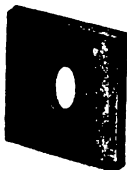
**Round Plate Washers**



Style No.	Trade No.	Bolt Fit	DIMENSIONS, INCHES			Approx. Net Wt., Lbs. Per 1000	List Price Per 100
			Diameter Hole	Outside Diameter	Thickness, Wire Gauge		
137360	7801	1/8	3/8	1	14	16	\$ 46
137362	7803	1/8	1/2	1 1/4	12	42	84
137364	7805	5/8	1 1/2	1 3/4	10	75	1 36
137365	7806	3/4	2	2	9	112	1 90

Furnished hot galvanized unless otherwise ordered.

**Square Plate Washers**



Style No.	Bolt Fit, Inches	Size, Inches	Approx. Net		Style No.	Bolt Fit, Inches	Size, Inches	Approx. Net	
			Wt. Lbs. Per 100	List Price Per 100				Wt. Lbs. Per 100	List Price Per 100
137331	1/4	2 x2 x1 1/2	15	\$2 10	137340	5/8	3x3x3/8	45	\$6 64
137333	1/4	2 1/4x2 1/4x3/8	25	3 48	137341	5/8	4x4x3/8	83	11 82
137335	1/4	3 x3 x3/8	45	6 64	137343	5/8	3x3x3/8	44	6 64
137336	5/8	2 x2 x1 1/2	14 1/2	2 10	137344	5/8	4x4x3/8	82	11 82
137338	5/8	2 1/4x2 1/4x3/8	25	3 48	137345	5/8	5x5x3/8	130	17 82

Furnished hot galvanized unless otherwise ordered.

**STRAIN PLATES AND POLE SHIMS**  
Hot Galvanized



STRAIN PLATE



HUBBARD & CO.

Style No.	Trade No.	Description	Size, Inches	PER 100	
				Approx. Net Wt., Lbs.	List Price
196221	7575	Strain Plate	4 x8	85	\$15 18
187273	7570	Pole Shim	1 x 1/2 x 8	45	6 84
187274	7571	Pole Shim	1 1/2 x 1/2 x 8	60	7 90

**WIRE-ROPE THIMBLES**

Hot Galvanized



Style No.	Trade No.	Size of Strand, Inches	PER 100	
			Approx. Net Wt., Lbs.	List Price
102151	7593	3/4	9 1/2	\$8 12
102152	7594	1/2	22	10 44
130787	7595	5/8	75	16 76

Furnished with ends open unless otherwise specified.

Order by Style Number

MISCELLANEOUS HARDWARE—Continued

ANCHOR OR GUY RODS



Style No.	Trade No.	DIMENSIONS		PER 100	
		Diameter Inches	Length Feet	Approx. Net Wt., Lbs.	List Price
186735	7405	1/2	5	355	\$62 20
188737	7406	1/2	6	410	71 48
188738	7407	1/2	7	465	80 70
188740	7415	5/8	5	350	80 80
188741	7416	5/8	6	400	93 36
188742	7417	5/8	7	450	108 14
188743	7418	5/8	8	500	118 68
188744	7426	5/8	6	475	130 34
188745	7427	5/8	7	525	148 10
188746	7428	5/8	8	575	166 84
188747	7429	5/8	9	625	183 48
188748	7438	1	8	1475	309 68
188749	7440	1	10	2850	372 30

Furnished hot galvanized unless otherwise ordered.

GUY HOOKS  
Hot Galvanized

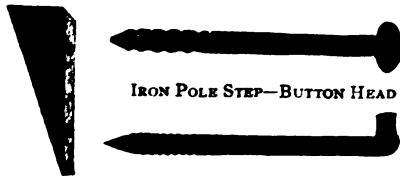


STYLE NO.  
206609

STYLE NO.  
196220

Style No.	Trade No.	Size, Inches	Description	PER 100	
				Approx. Net Wt., Lbs.	List Price
206609	7584	1 1/4 x 1/4 x 4	With one 1/2-inch hole	75	\$15 94
196220	7586	1 1/2 x 1/4 x 6	With two 1/2-inch holes	75	15 94

POLE STEPS FOR WOOD POLES

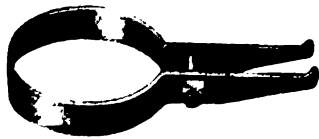


IRON POLE STEP—BUTTON HEAD

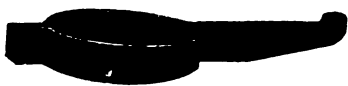
OAK POLE STEP IRON POLE STEP—HOOK HEAD

Style No.	Trade No.	Description	Size, Inches	PER 100	
				Approx. Net Wt., Lbs.	List Price
135018	.....	Oak, painted	1 1/2 x 2 1/4 x 7	50	\$1 40
82752	7123	Iron, galvanized hook head	1/2 dia. x 9	66	8 68
102119	7124	Iron, galvanized hook head	3/8 dia. x 9	81	11 70
136627	7125	Iron, galvanized hook head	5/8 dia. x 10	90	12 98
375757	7128	Iron, galvanized button head	5/8 x 9	84	12 00
375758	7129	Iron, galvanized button head	5/8 x 10	92	13 20

POLE STEPS FOR TUBULAR STEEL POLES  
Regularly Furnished Plain



SOLID STEP



SPLIT STEP

Style No.	Nominal Pole, Inches	Actual Pole, Inches	Diam. of Pole, Inches	PER 100 Wt., Lbs.	List Price	Style No.	Nominal Pole, Inches	Actual Pole, Inches	Diam. of Pole, Inches	PER 100 Wt., Lbs.	List Price
126603	4	4 1/2	2 1/2	215	\$28 50	252757	4	4 1/2	2 1/2	260	\$35 00
126604	4 1/2	5	2 3/8	230	30 50	252758	4 1/2	5	2 3/8	275	37 00
126605	5	5 1/2	2 3/4	245	32 50	252759	5	5 1/2	2 3/4	290	39 00
126606	6	6 3/4	2 7/8	260	35 00	252760	6	6 3/4	2 7/8	315	41 25
252753	7	7 3/4	2 7/8	295	38 50	252761	7	7 3/4	2 7/8	340	45 00
252754	8	8 3/4	3	320	42 25	252762	8	8 3/4	3	365	48 75
252755	9	9 3/4	3 1/8	345	46 00	252763	9	9 3/4	3 1/8	390	52 50
252756	10	10 3/4	3 1/2	375	50 00	252764	10	10 3/4	3 1/2	420	58 50

GROUND PIPES  
Hot Galvanized



Style No.  
252768

Trade No.	PER 100 Wt., Lbs.	List Price
9500	875	\$240 22

GROUND RODS  
Hot Galvanized

Style No.	Trade No.	Diameter Rod Inches	Length Rod Feet	Ground Wire	PER 100	
					Approx. Net Wt., Lbs.	List Price
196010	9555	3/4	5	Without	180	\$28 58
196011	9556	1	6	Without	215	33 84
196012	9566	1 1/2	6	Without	395	48 52
196013	9567	1 1/2	7	Without	460	68 74
196014	9576	5/8	6	Without	600	77 66
196015	9578	5/8	8	Without	800	108 44
196016	9505	1 1/2	5	With	340	60 58
196017	9506	1 1/2	6	With	405	64 48
196018	9516	5/8	6	With	615	91 68

Order by Style Number



## PORCELAIN INSULATORS

Porcelain is a vitreous, homogeneous mixture of clay, flint, and feldspar. Porcelain which is used for electrical purposes differs from general porcelain ware only in the proportions of the three base materials used, and in the refinements of its manufacture. These differences, however, make possible a porcelain which meets the highest mechanical and dielectric requirements.

The raw materials are finely ground, accurately proportioned, and intimately mixed in a fluid state. The mixed material is then reduced to a plastic state by filtering under pressure. Electrical porcelain is manufactured by three processes, known as the dry process, the casting process, and the wet process.

**Dry Process**—After filtering, the material is partly dried and ground to a crumbly condition, in which the granules are of the size of rice grains, or smaller, and in which there is just enough moisture so that a handful of the material will cling together when squeezed. The material is then pressed in steel moulds of the required shape. The pressed shapes are dried, finished to dimension, and glazed. Dry process porcelain can be moulded quite accurately into complicated shapes.

**Casting Process**—Porcelains of high dielectric strength and of complicated form can be made by pouring the fluid material into multipart plaster of paris moulds. The cast piece is removed from the mould after it has stiffened sufficiently to permit handling and finishing without distortion. It is then thoroughly dried and glazed. Plaster of paris is a particularly useful material for moulds, because it accelerates the drying of the porcelain body by its absorption of moisture.

**Wet Process**—Blocks of the plastic material about the consistency of putty are worked into the desired shape, and placed into plaster of paris moulds. The surface not in contact with the mould is then worked to the desired shape by machine forming or pressing. The piece is removed from the mould after it has partly dried and is stiff enough to handle. The surface which was in contact with the mould during the pressing operation is then finished to accurate dimensions. The body is then thoroughly dried and glazed.

Another method of making wet process porcelain is to extrude the plastic material into tubes or bars. Guy strain insulators, and tubes in which all the surface elements are parallel, are formed in this way. The pieces are cut to the desired length and finished, after the material is partly dried. Porcelain casings with rain sheds are made from cylindrical blanks which are formed in this way and are turned to the desired shape on a lathe after the material has been dried to a workable condition.

**Glaze**—The glaze on porcelain is a mixture of the same materials used in the body, which fuses into a glass at the firing temperature of the porcelain. This serves to cover the porcelain with a glassy surface that is impervious to moisture and that cleans more readily than the natural unglazed porcelain surface. A great variety of glaze colors can be made by use of inorganic or metallic pigments. The common ones, however, are white and brown. The essential thing about the glaze, if the color is correct, is to have it fit the porcelain; that is, the contractions and expansions of the glaze must be the same as those of the porcelain. If contraction of the glaze is greater, the glaze cracks with many fine crisscross fissures, called crazing. If the contraction is not so great cracks will occur with chipping off of small pieces of the glaze. This is called shivering. These troubles do not occur if the glaze is so proportioned that it conforms to the surface of the porcelain body during thermal changes.

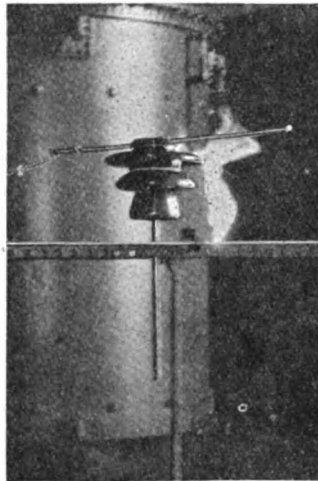
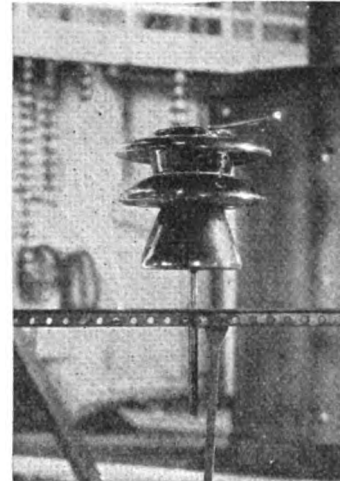
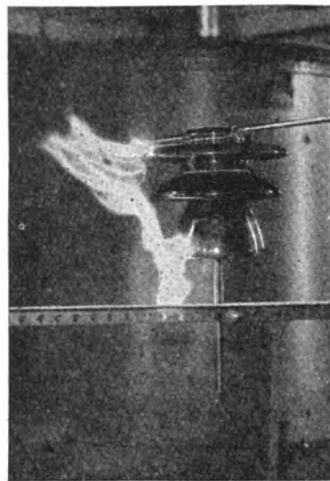
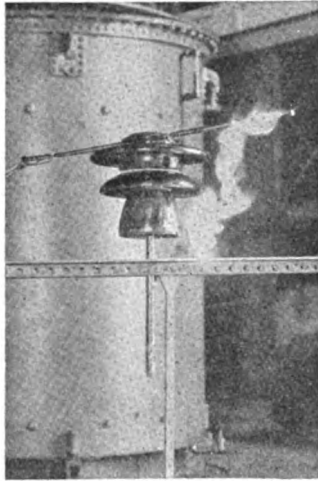
**Firing**—Natural gas, crude oil, and coal are the fuels that have been used commercially in firing electrical porcelain. The Westinghouse High Voltage Insulator Company uses the most convenient fuel, natural gas. The supply of this, however, is becoming less, and soon it will probably be necessary to use other fuels during a part of the winter. An oil tank of sufficient capacity to supply fuel during periods of gas shortage has been installed and the kilns have been equipped with the latest type of combination oil and gas burners. The firing temperature is easily controlled while using either of these fuels. The temperature in all parts of the kiln can be kept uniform while rising to the maximum. There is, moreover, with their use, freedom from any discoloration of the glaze because of the presence of smoke and gas—an unavoidable evil where coal is used.

**General**—A great deal has been said about the virtues of different manufacturers' products of porcelain, but, in general, there is no great difference in the materials used. The chief differences result more from the checking of raw materials and the quality of workmanship. Much progress has been made in the last few years in the manufacture of porcelain of uniform texture and with consequent uniformity of mechanical and dielectric strengths. At present the greatest efforts are being directed toward obtaining refinements in manufacture which will result in a more uniform product.

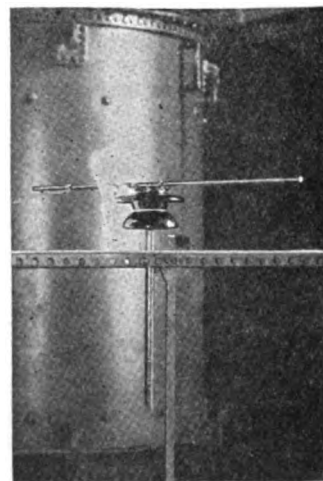
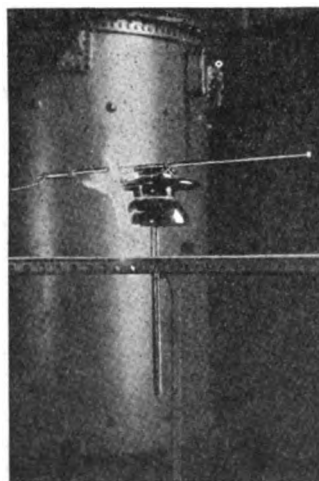
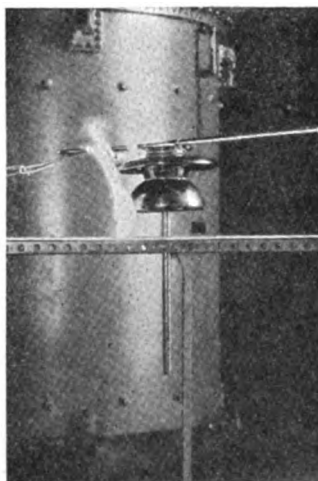
**Inspection**—The insulator parts are inspected during each process of manufacture. A careful visual inspection is made before glazing and after the glazed pieces are taken from the kiln. The assembled multipart, pin-type insulators and suspension insulators are visually inspected for defects in alignment of parts, after the final electrical test.

## PORCELAIN INSULATORS—Continued

## METHODS OF TESTING PORCELAIN INSULATORS



The arc-over voltages listed in this catalogue were obtained by the method described in the design-test specifications formulated by the Insulator Sub-committee of the A.I.E.E. Standards Committee. Arc-over voltages obtained in this way are lower than those obtained by the usual method of inverting the insulators in a pan of water and testing with a transformer having the middle point grounded.



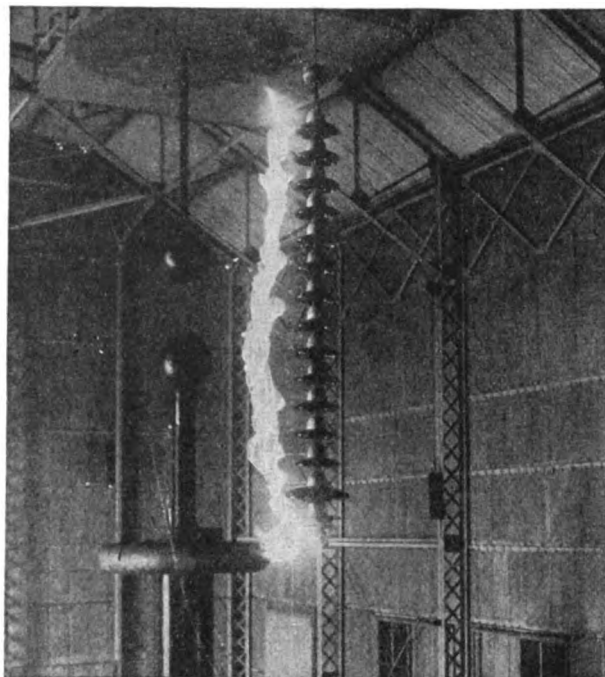
## PORCELAIN INSULATORS—Continued

**Routine Electrical Tests**—The porcelain insulator parts, after visual inspection, are inverted in broad metal pans which are connected to one side of an electrical circuit. A light chain is hung from the other side of the circuit into each insulator part. In this manner, 50 to 200 parts are tested at one time. The parts are tested for five minutes at a potential which is somewhat in excess of flash-over. The electrical characteristics of the testing apparatus are such as to combine the impact test with the 60-cycle test. This method of testing has been found by careful investigation to be the most effective in determining which parts are defective. The multipart pin-type insulators and suspension insulators are given a similar test after assembly.

**Design Tests**—The facilities of the Westinghouse Company for testing insulators are unusually modern and complete. The routine testing can be done at the Insulator Works. The design testing, which is more severe, must be done at the High Voltage Laboratory at North Trafford, Pennsylvania. Here are available a 500,000-volt transformer and a 1,000,000-volt transformer.

Upon the completion of the first insulators of a new type, and before approval is finally given to their design, some of these new insulators are thoroughly tested. This testing is done to determine not so much the quality of the porcelain as whether the size and shape of the insulator are correct.

Some testing of this sort has been done at voltages approximating one million. This was accomplished by connecting two transformers in series, grounding the connection between them, and using the voltage across the line terminals. An artificial ground, at a potential of one-half the voltage above ground,



A STRING OF FIFTEEN SUSPENSION INSULATORS ARCING OVER

was used. It was in this way that one million volts was first obtained—by the Westinghouse Company, in 1913. However, even though the greatest care be taken with this method, the results secured are often unreliable. Testing with a single transformer capable of delivering full test voltage above ground ensures much more accurate values. Realization that the most accurate test data could only be obtained by the single-transformer method caused the Westinghouse Company to construct its 1,000,000-volt testing transformer.

## CEMENTING PORCELAIN INSULATORS

For cementing porcelain, Neat Portland Cement is used, mixed with water in proportions by weight found by thorough investigation to give the most satisfactory results. The process depends on the type of design. Where metal parts are assembled,

it is desirable to place the insulators in a temperature chamber for a period, in order to allow for temperature changes that may occur after the insulators are installed in service.

## STANDARD PIN HOLES

The standard pin hole of an insulator has four threads per inch. The standard diameters are 1 inch and  $1\frac{3}{8}$  inches. These dimensions are the

extreme diameters at the small end of the pin hole. The taper for both standards is a  $\frac{1}{8}$  inch increase in diameter per inch in length.

## PORCELAIN INSULATORS—Continued

## STANDARD PACKAGES

Our porcelain insulators are prepared for shipment by experienced packers. Standard packages have been selected which are economical and will prevent breakage of the contents. Material will be

received in the most satisfactory manner if the insulators are ordered in quantities that allow shipment in standard packages.

## PIN HEIGHT

The recommended minimum height of pin has been found the most satisfactory for general application. The use of a pin of less height than specified will lower the flashover voltages. The variation

of flashover voltage with height of the pin will depend to a considerable extent upon the type of insulator under consideration.

## MECHANICAL STRENGTH OF PIN-TYPE INSULATORS

Our designs of pin-type insulators will withstand greater side pulls than the commercial insulator pins. In selecting insulator pins, care should be taken to determine whether the portion of the pin inside the pin hole of the insulator bends under the light loads. This bending may apply stresses

to the insulator which will cause failure. When cemented on a solid steel pin the insulator will withstand a side pull of 4000 to 5000 pounds applied at the wire groove perpendicular to the axis of the insulator.

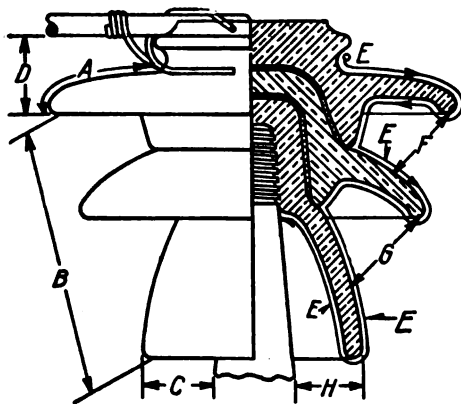
## LINE VOLTAGE RATING

Engineers often assert that the flashover voltages in the insulator catalogues depend on the manufacturer. It is quite possible for the data to vary, because it depends to a large extent on conditions of test such as: type of crossarm and pin, height of insulator above arm, size of tie and line wire, method of attachment to insulator, connection to testing transformer, capacity of testing equipment, method of recording voltage, atmospheric conditions, condition of insulator surface, character of water used in wet test, and rate of precipitation as well as the pressure used. All of these factors should be taken into consideration since each one will materially affect the value of the flashover voltage. The line voltage ratings may deviate still further since they are usually derived by applying a factor to the dry and wet flashover voltages.

In general, if several insulators of different manufacture, but of equivalent design and over-all dimen-

sions, are tested under identical conditions, equal flashover voltages will be obtained, regardless of the specific porcelain body used by any manufacturer. The flashover of an insulator, either wet or dry, is caused by the overstressing of the air path between the conductor and the crossarm or pin. The overstressing may be practically concentrated at the line and tie wire or may also occur at the external edges of the cement joints between shells. The areas of the insulator surface covered by the overstressed air (corona) increase as the voltage applied to the insulator increases, until static streamers spread over the surface of the top shed, and, in many designs, between sheds. The initial flashover tends to follow the formation of static streamers and, for equal dimensions, the insulator that develops the minimum of static discharges will have the highest flashover voltage.

## ARCING AND LEAKAGE DISTANCES OF INSULATORS



The sum of distances  $A+B+C$  or  $D+B+C$  (depending on whether  $A$  or  $D$  is the shorter distance) in the accompanying illustration gives the dry arcing distance. The sum of  $F+G+H$  gives the arcing distance when wet under a driving rain at 45 degrees from the vertical. When the surfaces are wet the arc will tend to travel along the shortest path from the edge of one shell to the outer surface of the next. The exact path of the arc will depend somewhat on the shape of the parts and will tend to lie between 45 degrees and a normal from the edge of one shell to the outer surface of the next lower shell. The leakage distance is illustrated by the line  $E$ .

A 1-inch pin was used in the set-up from which the wet arcing distances shown in this catalogue were obtained.

## PORCELAIN INSULATORS—Continued

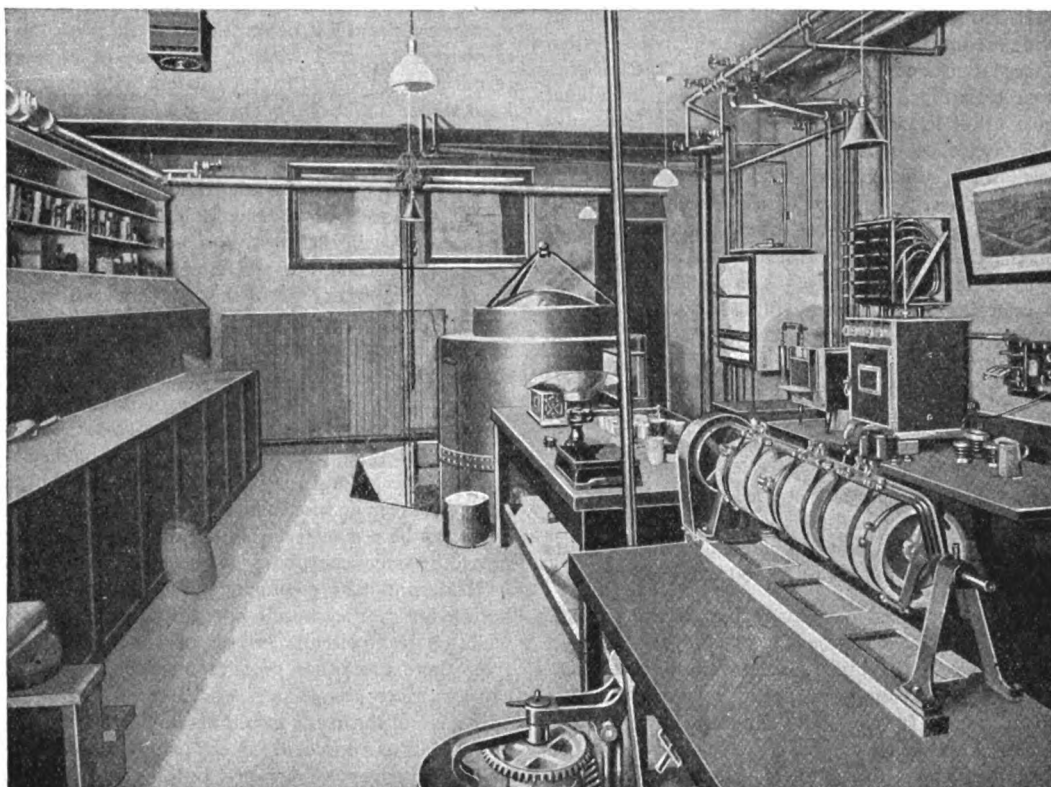
## MOISTURE ABSORPTION OF PORCELAIN INSULATORS

Opinions of ceramic and electrical engineers differ regarding porosity. Our research engineers have concluded that the most accurate indication of porosity is obtained by immersing small pieces of porcelain in an aniline dye solution under pressure.

The sample pieces should be broken from various sections of the insulator and three-quarters of the

surface should be free from glaze. The comparative porosity can be determined by penetration of the dye solution and by the intensity of color.

Modern improvements in the control of kiln firing have practically eliminated porosity as a cause for insulator depreciation, consequently much less importance is now attached to this property.



CERAMIC LABORATORY AT RESEARCH BUILDING

## EFFECT OF LOCATION

In determining the insulator for any given installation, local conditions of climate, extent of lines, nature of country traversed, etc., should be carefully considered. An insulator that would afford adequate protection in the dry interior of California where electrical storms are unknown, would be entirely

unsuitable for service along the coast where it would be subjected to salt fogs, or in districts where electrical storms are frequent.

Requests for recommendations should be accompanied by complete information relative to the above factors.

## OVERHEAD GROUND WIRES

The phenomenon of insulator puncture from lightning is an old one but only began to be manifest when insulators were first installed on metal pins.

An overhead line becomes charged during the storm with a bound charge held in place by the clouds overhead regardless of the currents pass-

ing back and forth over the line. When a lightning discharge occurs these bound charges on the line underneath the particular cloud which has discharged are suddenly released. So long as the charges were bound their potential was neutralized by the cloud charge and consequently their presence could not be detected by any means.

## PORCELAIN INSULATORS—Continued

As soon, however, as these charges are released and no longer neutralized by a charge of opposite potential in the clouds, they attempt to pass lengthwise on the line and also over the insulators to ground. If the operating potentials are moderate and the insulators rugged and the poles of wood, the charges may pass over harmlessly on several poles and do no more than slightly mar the surface of the pole.

It frequently occurs that ribbons about  $\frac{3}{4}$  inches wide are cut from the surface of cedar poles by discharges over a 6600-volt insulator where the line goes over high hills. The resistance of each individual pole takes most of the energy and, as is usually the case, the puncture value of the lower voltage insulator is sufficiently high to cause the discharge to pass over the surface of the insulator. As the voltages increase, however, there is more possibility of the discharge being concentrated on one pole. Further, the insulators do not as a rule have as high a margin of puncture voltage over flash-over voltage. The result is that on voltages of 44,000 volts and above, insulators on wood poles and wood pins are sometimes punctured.

The whole tendency, however, to puncture insulators is very much increased if there is metal inside the pin or if the pin is metal, and is particularly increased if this pin is grounded. The puncturing of insulators on metal pins is then likely to occur on voltages as low as 6600 volts, although it occurs more frequently at about 25,000 volts and upward.

Some effort has been made by operating people to relieve this condition by placing lightning arresters along the line. Unless there is a lightning arrester at every insulator, however, this is of little value. It has been found that the disturbances caused by the release of the bound discharges described above are more of a local nature. It is quite analogous to the explosion of dynamite inside of a pipe that may be open at both ends. The dynamite will burst the pipe in spite of the apparently free passage at each end. It has been found for example that an insulator may be punctured by lightning on a line that is solidly grounded less than a mile away.

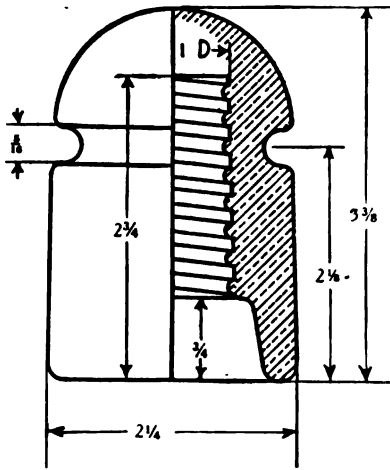
The only effective remedy for this condition is to prevent these bound charges from existing on the line by carrying sufficient ground potential over the top of the line to prevent it. This cannot be entirely accomplished without covering the line with a roof of grounded material, but it can be very nearly accomplished by the use of grounded overhead conductors. These conductors should, however, be grounded at every pole.

We recommend, where practicable, that a high voltage overhead line be put up with the protection of overhead ground wires. There are other ways of mitigating the evil to some extent without overhead wires. These depend somewhat on the amount of power back of the line and on the degree of continuity which is essential to satisfactory operation. The use of a gap to permit the discharge to pass around the insulator without puncture will in many cases save the insulator at the expense of a short circuit on the line. If the circuit-breaker equipment is complete and if there is not too much synchronous apparatus which will be thrown out of step, involving inconvenience to customers, this scheme may be quite successful. There are other schemes involving momentary grounding at the power house of the wire in trouble. This momentary grounding suppresses the arc around the insulator and the ground may then be pulled off by a circuit-breaker or fuse in the grounding device and operation be resumed without serious disturbance, providing only one phase has been affected. This method cannot be recommended generally without knowledge of the specific operating conditions, for while on some circuits it has proven quite effective, there are other circuits on which it would cause more trouble than it would cure.

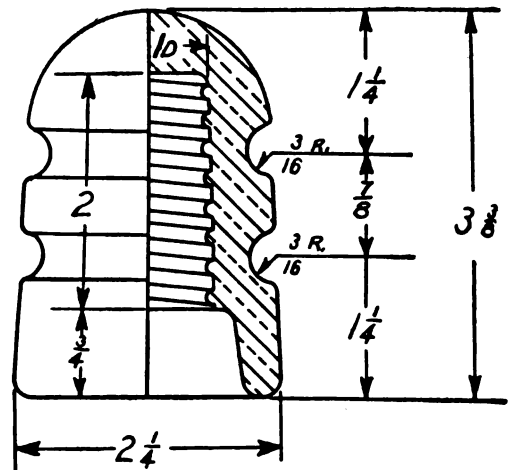
In general the use of insulators having high puncture value as compared to arc-over value will reduce the danger of puncture, but if there is much power behind the line the arc following an arc-over may destroy the insulator just as completely as a puncture would. In this case a gap around the insulator may be a help providing it does not increase by a troublesome amount the number of arc-overs. The gap must, however, have a smaller sparking value than the insulator itself to do this.

**PORCELAIN PIN-TYPE INSULATORS**

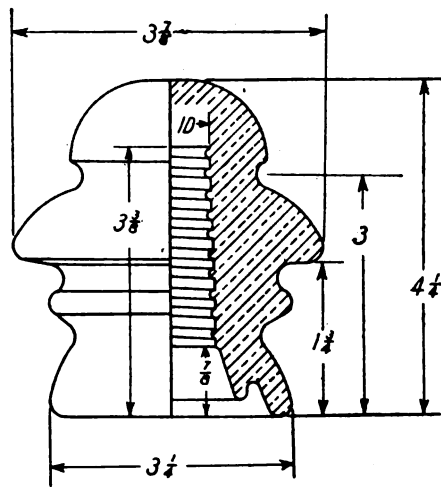
TELEPHONE, TELEGRAPH AND ELECTRIC LIGHT SERVICE



**No. 100**



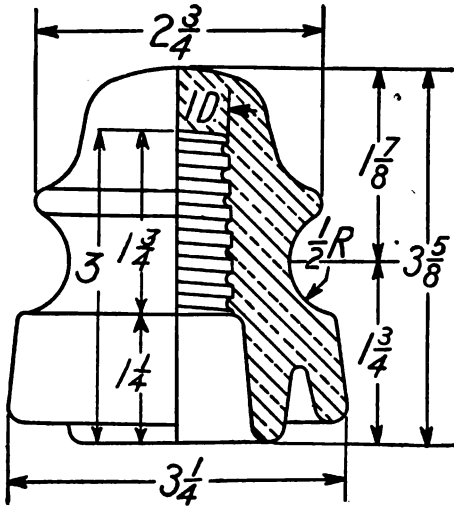
**No. 110**



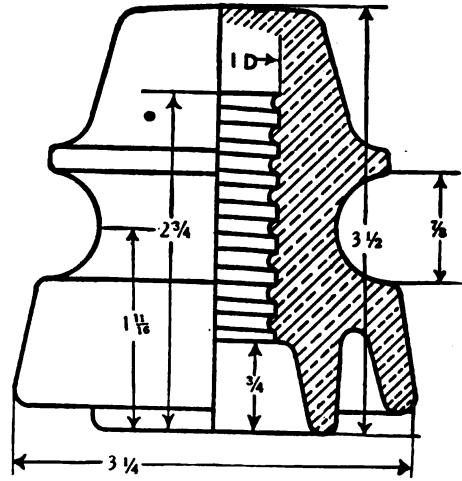
**No. 120**

Insulator No. ....	100	110	120
Diameter of insulator, inches.....	2 1/4	2 3/8	3 3/8
Height of insulator, inches.....	3 3/8	3 1/2	4 1/4
Diameter of wire groove, inches.....	5/8	3/8	3/8
Size of pin hole, inches.....	1	1	1
Approximate net weight per 100 in pounds.....	60	56	176
Approximate weight packed per 100 in pounds.....	75	72	250
Number per box.....	300	300	100
List price per 100.....	\$13 25	\$13 25	\$40 00

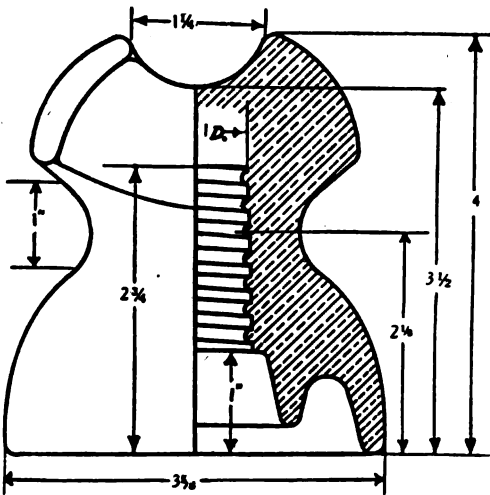
PORCELAIN PIN-TYPE INSULATORS—Continued



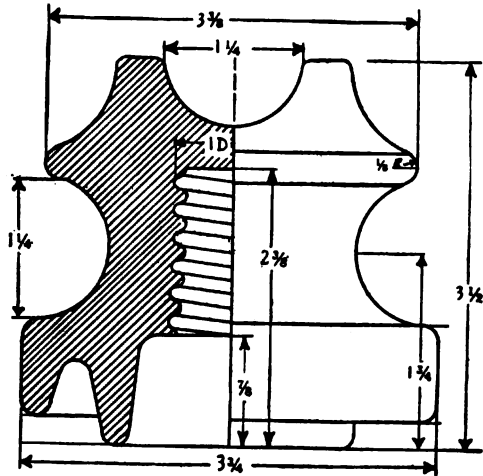
No. 104



No. 114



No. 106

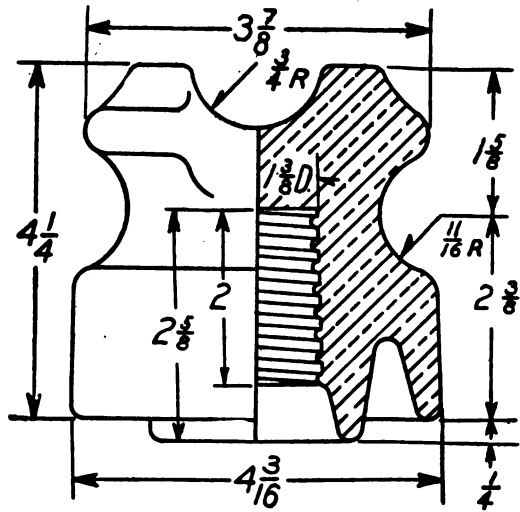


No. 116

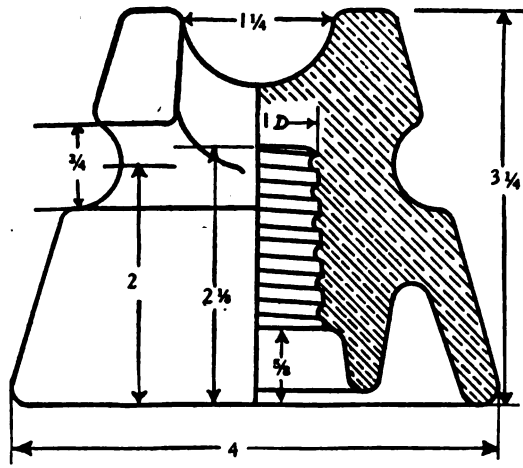
Insulator No.....	104	114	106	116
Trade voltage rating.....	4400	4400	6600	6600
Dry arc-over voltage.....	40000	40000	45000	50000
Leakage distance, inches.....	4	3 3/4	4	3 3/4
Wet arcing distance, inches.....	1	1	1 1/8	1 1/4
Diameter of insulator, inches.....	3 1/4	3 1/4	3 5/8	3 3/4
Height of insulator, inches.....	3 3/4	3 1/2	4	3 1/2
Diameter of wire groove, inches.....	1	3/8	1 1/4	1 1/4
Size of pin hole, inches.....	1	1	1	1
Approximate net weight per 100 in pounds....	110	105	140	120
Approximate weight packed per 100 in pounds	130	125	175	150
Number per box.....	200	200	150	150
Minimum pin height recommended.....	5 inches	5 inches	5 inches	4 1/2 inches
List price per 100.....	\$21 75	\$21 75	\$40 00	\$40 00



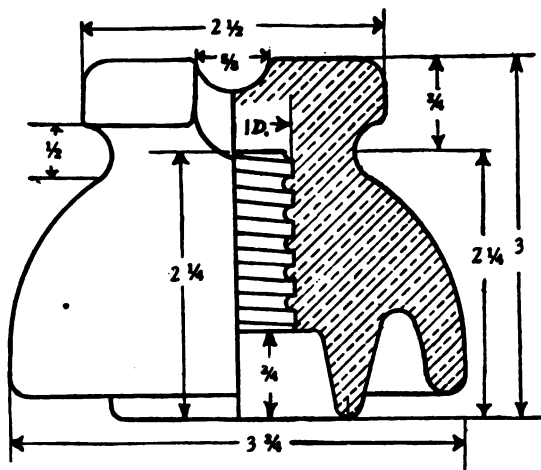
PORCELAIN PIN-TYPE INSULATORS—Continued



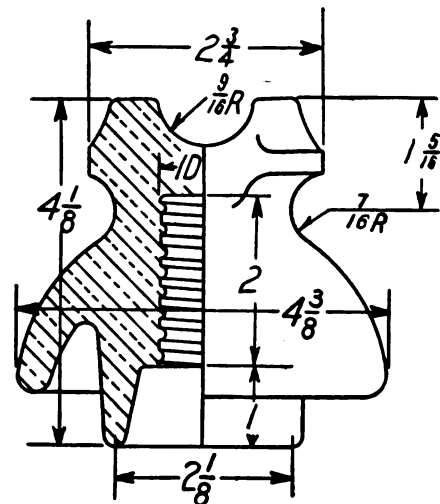
No. 126



No. 136



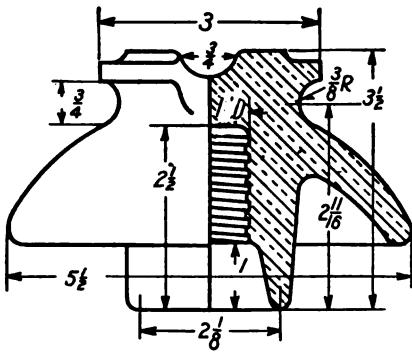
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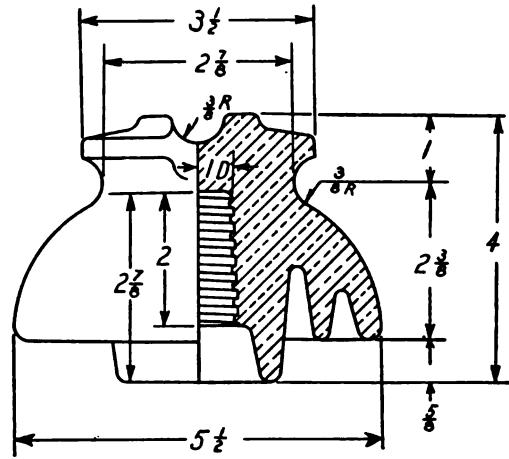
No. 1011

Insulator No.	126	136	146	1011
Trade voltage rating	6600	6600	7500	13000
Dry arc-over voltage	55000	55000	55000	60000
Leakage distance, inches	5	5	5	6 3/4
Wet arcing distance, inches	1 1/2	1 1/2	1 1/4	1 3/8
Diameter of insulator, inches	4 1/4	4	3 3/4	4 3/8
Height of insulator, inches	4 1/8	3 1/4	3	4 1/8
Diameter of top groove, inches	1 1/2	1 1/4	3/8	1 3/8
Size of pin hole, inches	1 3/8	1	1	1
Approximate net weight per 100 in pounds	275	125	140	180
Approximate weight packed per 100 in pounds	325	150	175	230
Number per package	100	150	150	100
Minimum pin height recommended	5 inches	4 1/2 inches	4 1/2 inches	5 1/2 inches
List price per 100	\$68 25	\$31 75	\$31 75	\$53 25

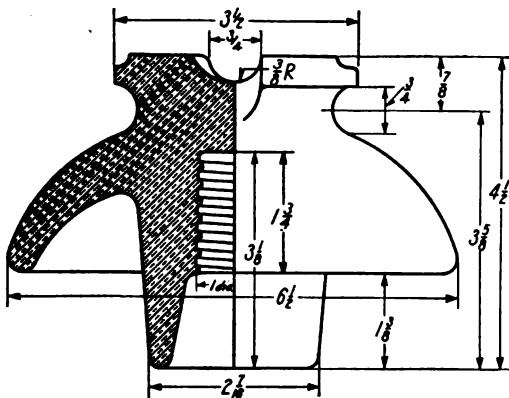
PORCELAIN PIN-TYPE INSULATORS—Continued



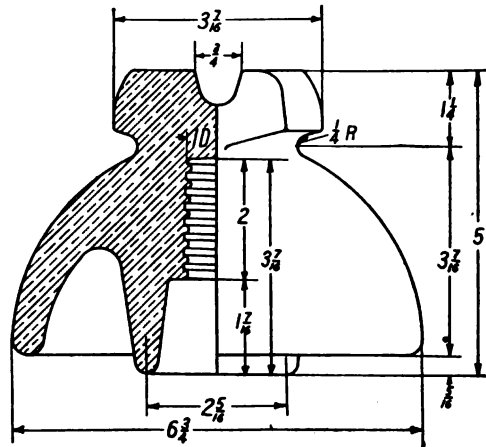
No. 1111



No. 1013



No. 1213



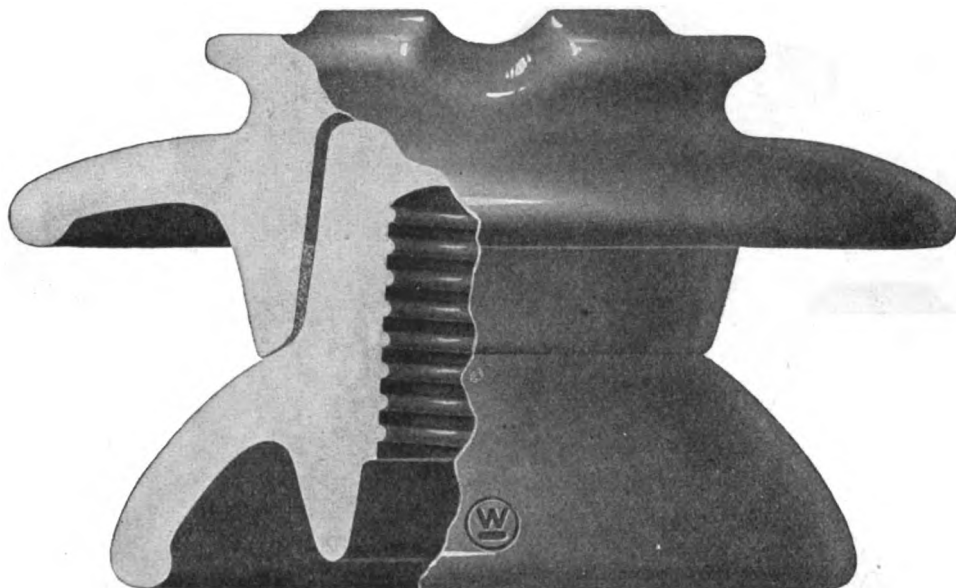
No. 1413

Insulator No.	1111	1013	1213	1413
Trade voltage rating	13500	17000	18000	23000
Dry arc-over voltage	60000	70000	70000	85000
Leakage distance, inches	6 1/2	8 1/2	9	10 1/2
Wet arcing distance, inches	2 1/4	2	3	2 1/2
Diameter of insulator, inches	5 1/2	5 1/2	6 1/2	6 3/4
Height of insulator, inches	3 1/2	4	4 1/2	5
Diameter of wire grooves, inches	3/4	3/4	3/4	3/4
*Size of pin hole, inches	1	1	1	1
Approximate net weight per 100 in pounds	240	300	360	500
Approximate weight packed per 100 in pounds	335	440	575	780
Number per box	80	60	45	36
Minimum pin height recommended	4 inches	5 1/2 inches	5 inches	5 1/2 inches
List price per 100	\$53 25	\$95 00	\$90 00	\$121 00

\*Note:—Similar insulators can be furnished with 1 3/8-inch pin holes when ordered specially.

Insulator No. with 1 3/8-inch pin hole	1211	1113	1313	1513
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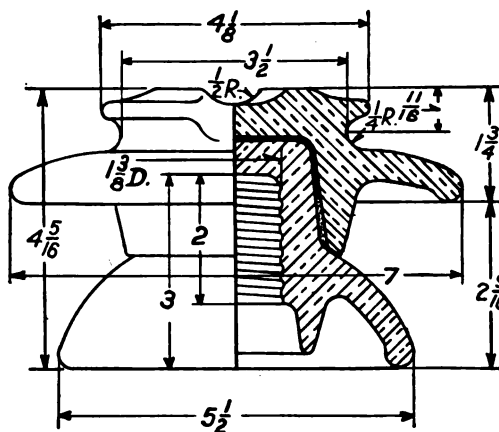
PORCELAIN PIN-TYPE INSULATORS—Continued



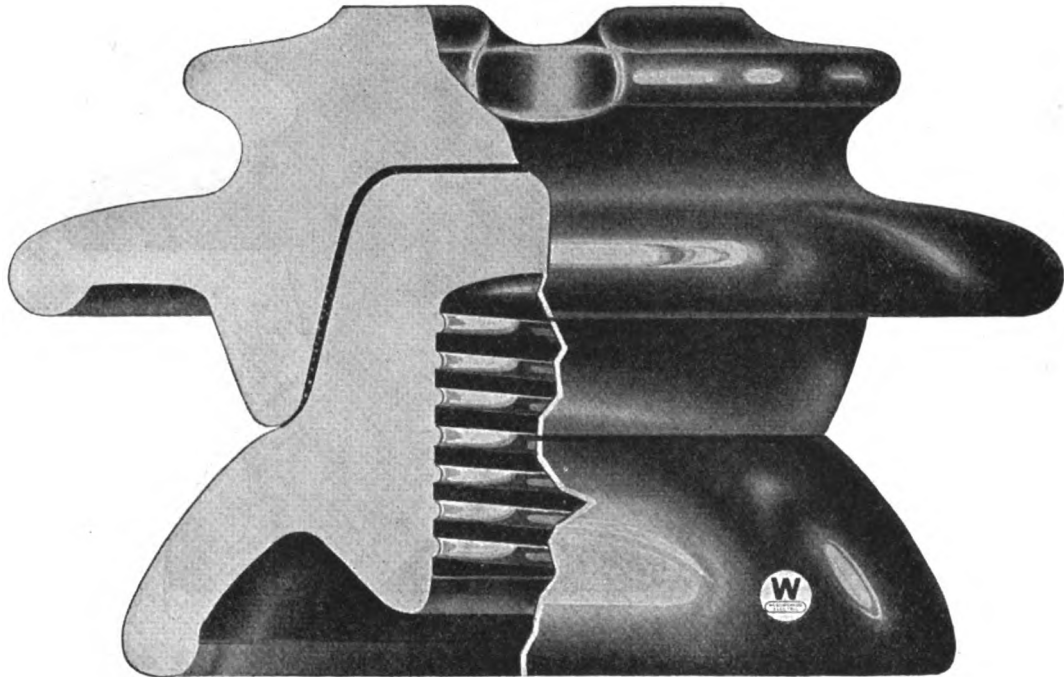
TRADE **FARADOID** MARK  
PATENTED

No. 2515

Trade voltage rating .....	25000
Dry arc-over voltage .....	80000
Leakage distance, inches .....	9½
Wet arcing distance, inches .....	3¾
Diameter of insulator, inches .....	7
Height of insulator, inches .....	4½
Diameter of top groove, inches .....	1
Size of pin hole, inches .....	1⅜
Approximate net weight per 100 in pounds .....	450
Approximate weight packed per 100 in pounds .....	655
Number per box .....	36
Minimum pin height recommended .....	6 inches
List price per 100 .....	\$148 00



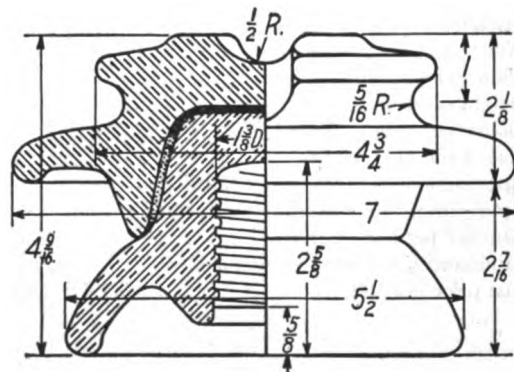
PORCELAIN PIN-TYPE INSULATORS—Continued



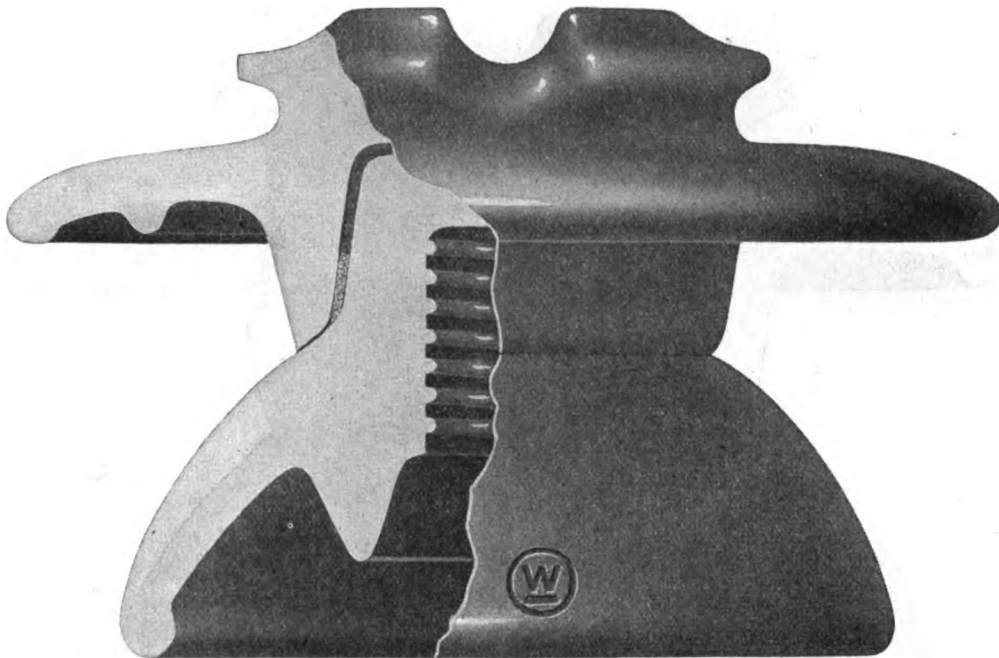
TRADE **FARADOID** MARK  
PATENTED

No. 2015

Trade voltage rating.....	25000
Dry arc-over voltage.....	80000
Leakage distance, inches.....	8½
Wet arcing distance, inches.....	3½
Diameter of insulator, inches.....	7
Height of insulator, inches.....	4¾
Diameter of top groove, inches.....	1
Size of pin hole, inches.....	1¾
Approximate net weight per 100 in pounds.....	575
Approximate weight packed per 100 in pounds.....	800
Number per package.....	36
Minimum pin height recommended.....	6 inches
List price per 100.....	\$161 00



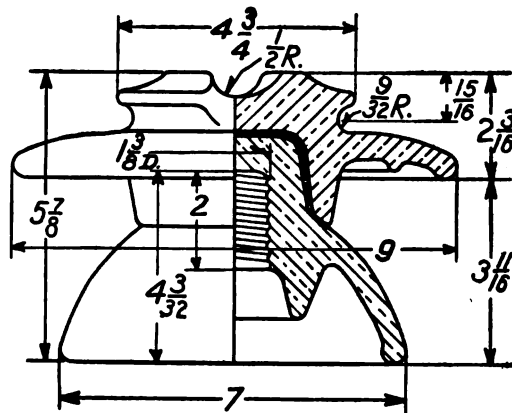
PORCELAIN PIN-TYPE INSULATORS—Continued



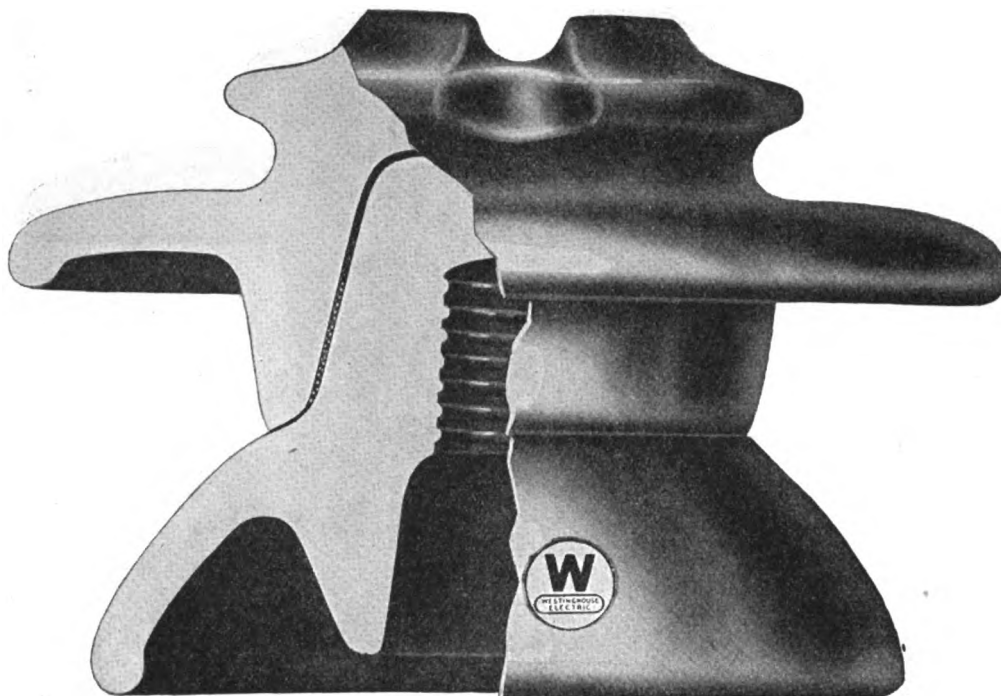
TRADE **FARADOID** MARK  
PATENTED

No. 2522

Trade voltage rating.....	35000
Dry arc-over voltage.....	105000
Leakage distance, inches.....	14 $\frac{7}{8}$
Wet arcing distance, inches.....	5
Diameter of insulator, inches.....	.9
Height of insulator, inches.....	5 $\frac{7}{8}$
Diameter of top groove, inches.....	.1
Size of pin hole, inches.....	1 $\frac{3}{8}$
Approximate net weight per 100 in pounds.....	900
Approximate weight packed per 100 in pounds.....	1300
Number per open crate.....	6
Minimum pin height recommended.....	9 inches
List price per 100.....	\$240 00



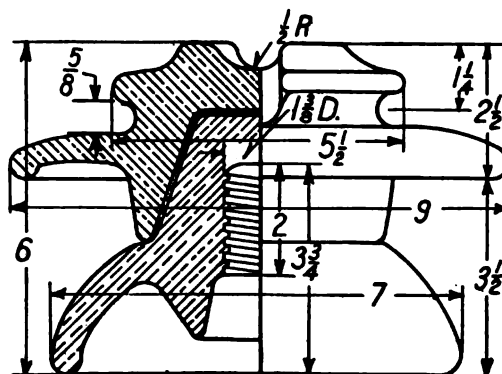
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

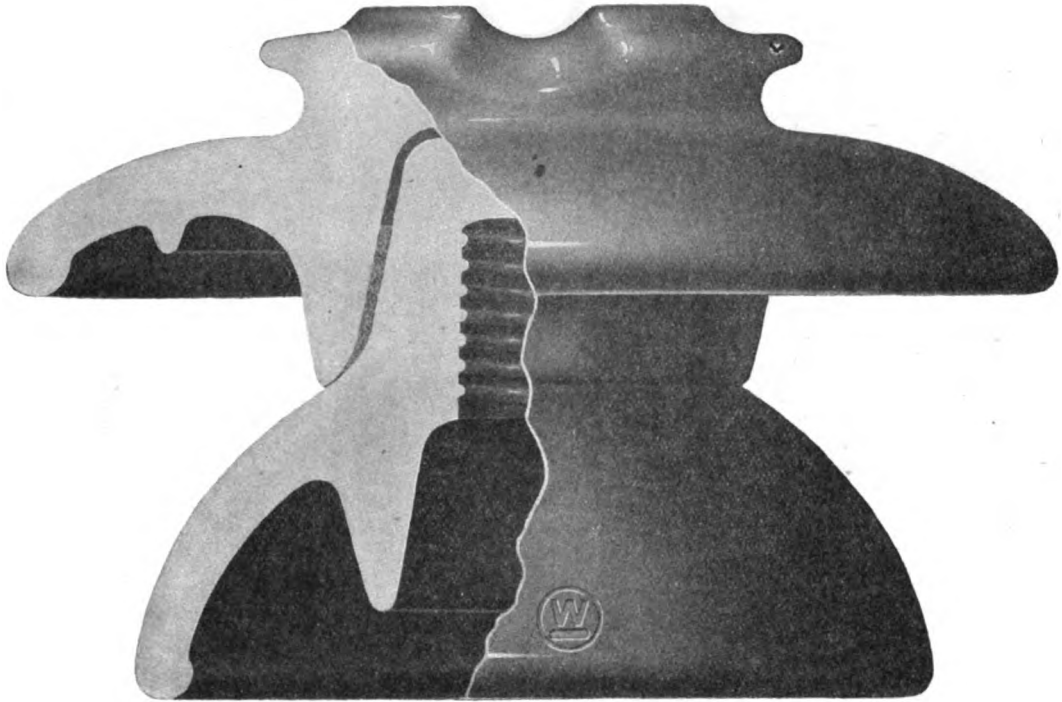
No. 2022

Trade voltage rating.....	35000
Dry arc-over voltage.....	110000
Leakage distance, inches.....	13¾
Wet arcing distance, inches.....	4¾
Diameter of insulator, inches.....	.9
Height of insulator, inches.....	.6
Diameter of top groove, inches.....	.1
Size of pin hole, inches.....	1¾
Approximate net weight per 100 in pounds....	1100
Approximate weight packed per 100 in pounds.	1500
Number per open crate.....	6
Minimum pin height recommended.....	7 inches
List price per 100.....	\$256 00



13-117A

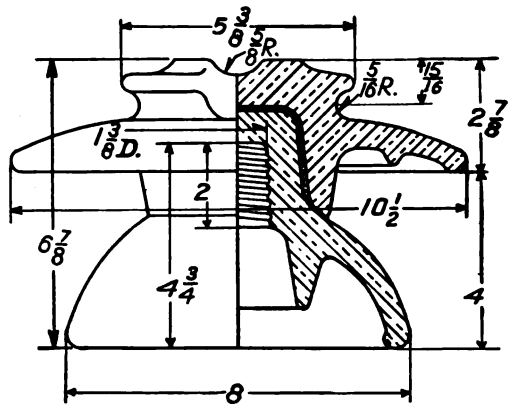
PORCELAIN PIN-TYPE INSULATORS—Continued



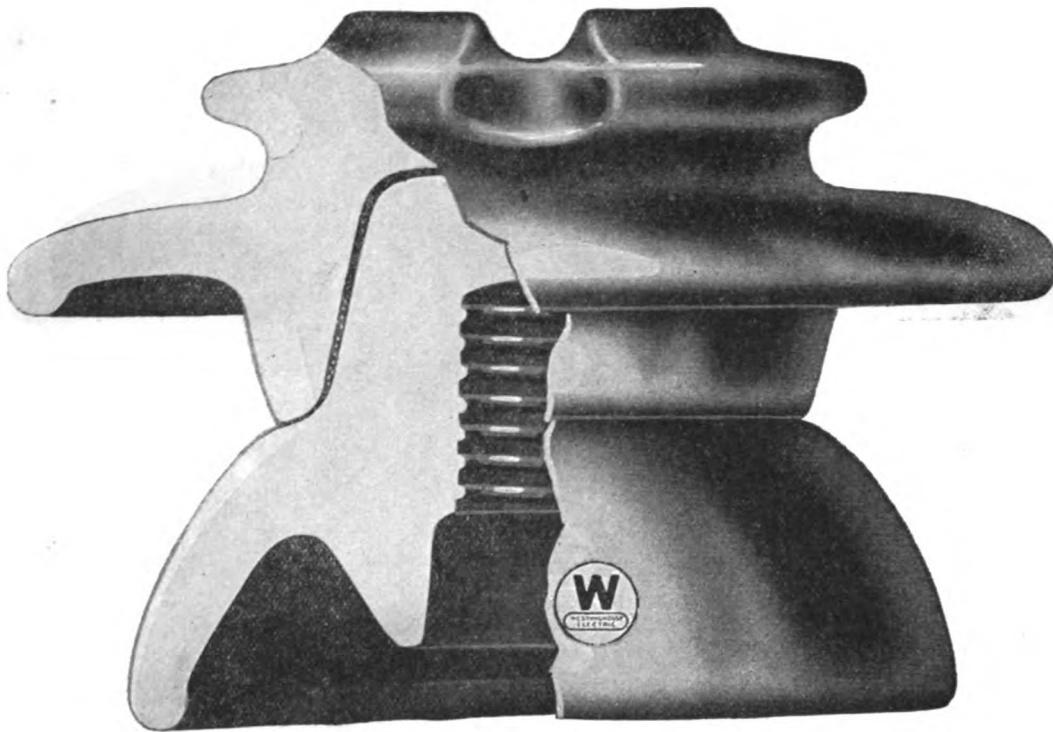
TRADE **FARADOID** MARK  
PATENTED

No. 2533

Trade voltage rating .....	45000
Dry arc-over voltage .....	125000
Leakage distance, inches .....	19
Wet arcing distance, inches .....	5 $\frac{3}{8}$
Diameter of insulator, inches .....	10 $\frac{1}{2}$
Height of insulator, inches .....	6 $\frac{7}{8}$
Diameter of top groove, inches .....	1 $\frac{1}{4}$
Size of pin hole, inches .....	1 $\frac{3}{8}$
Approximate net weight per 100 in pounds....	1200
Approximate weight packed per 100 in pounds.	1700
Number per open crate.....	6
Minimum pin height recommended.....	9 inches
List price per 100.....	\$300 00



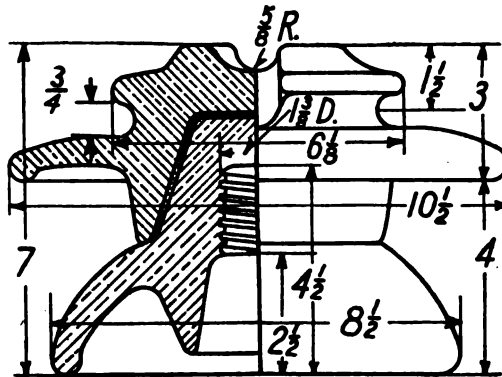
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

No. 2033

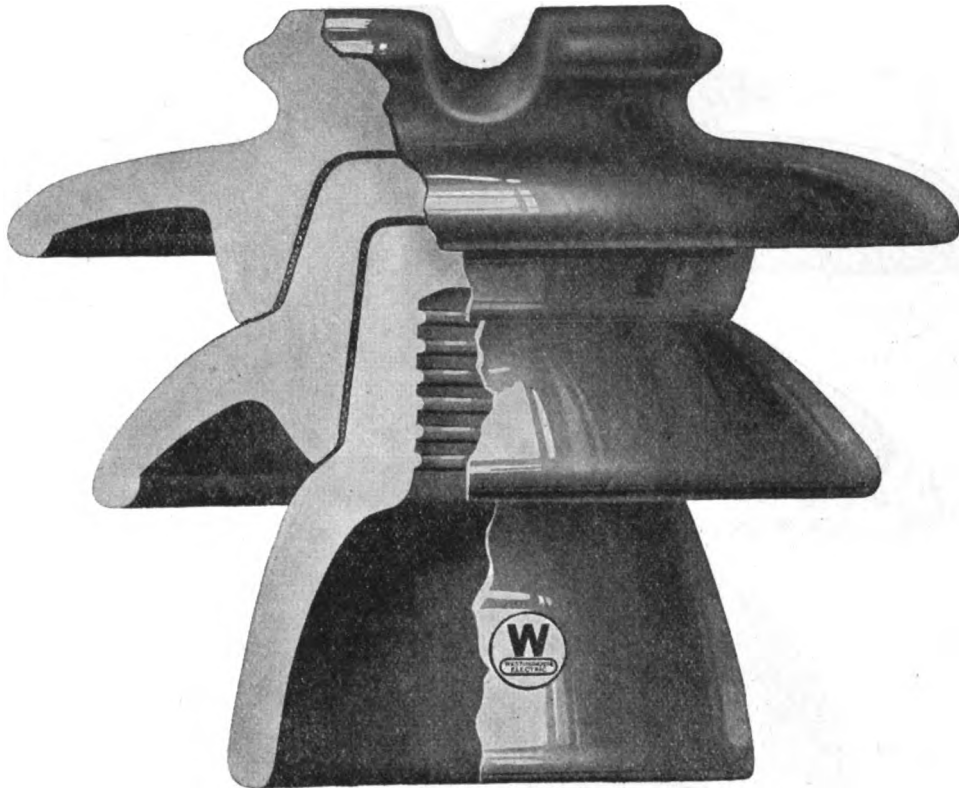
Trade voltage rating.....	45000
Dry arc-over voltage.....	125000
Leakage distance, inches.....	17¼
Wet arcing distance, inches.....	6
Diameter of insulator, inches.....	10½
Height of insulator, inches.....	7
Diameter of top groove, inches.....	1¼
Size of pin hole, inches.....	1⅜
Approximate net weight per 100 in pounds....	1600
Approximate weight packed per 100 in pounds.	2300
Number per open crate.....	6
Minimum pin height recommended.....	9 inches
List price per 100.....	\$338 00



13-119A



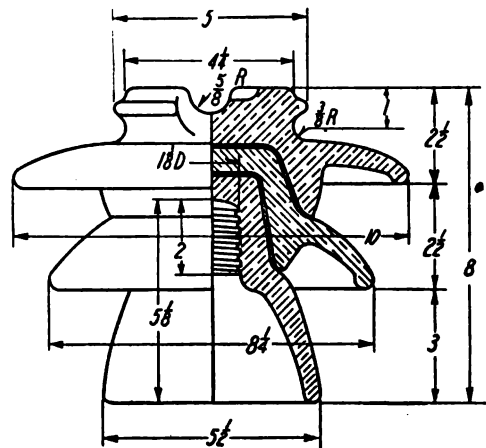
PORCELAIN PIN-TYPE INSULATORS—Continued



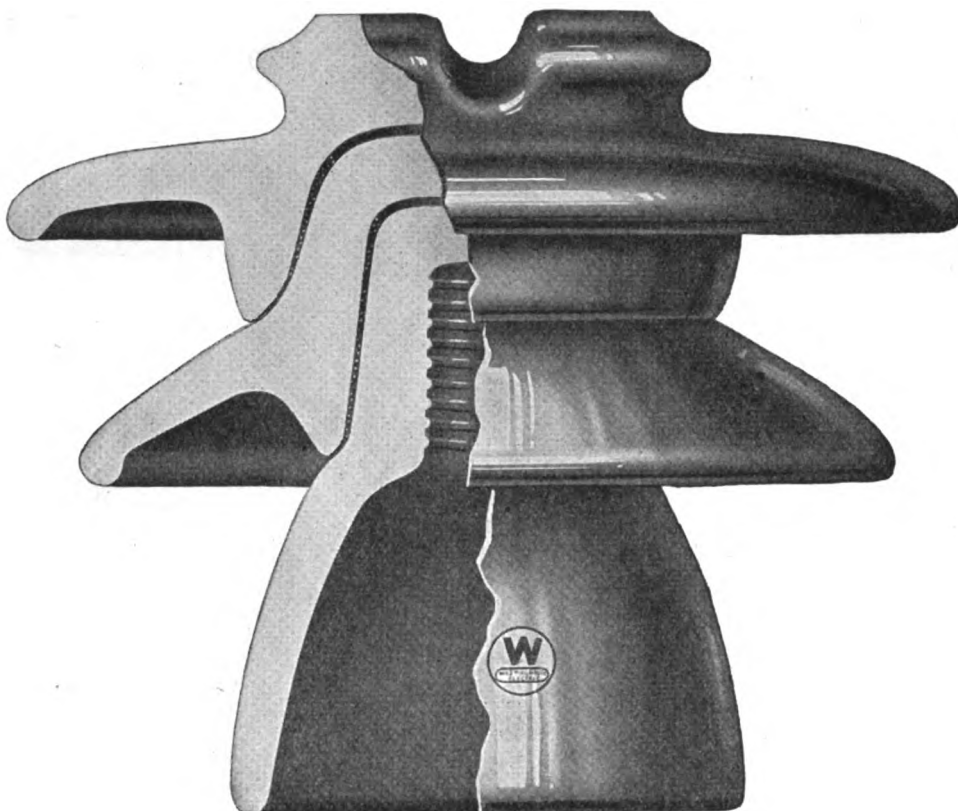
TRADE **FARADOID** MARK  
PATENTED

No. 3533

Trade voltage rating.....	45000
Dry arc-over voltage.....	125000
Leakage distance, inches.....	19½
Wet arcing distance, inches.....	5¾
Diameter of insulator, inches.....	10
Height of insulator, inches.....	8
Diameter of top groove, inches.....	1¼
Size of pin hole, inches.....	1¾
Approximate net weight per 100 in pounds....	1450
Approximate weight packed per 100 in pounds.	2000
Number per crate.....	6
Minimum pin height recommended.....	8 inches
List price per 100.....	\$376 00



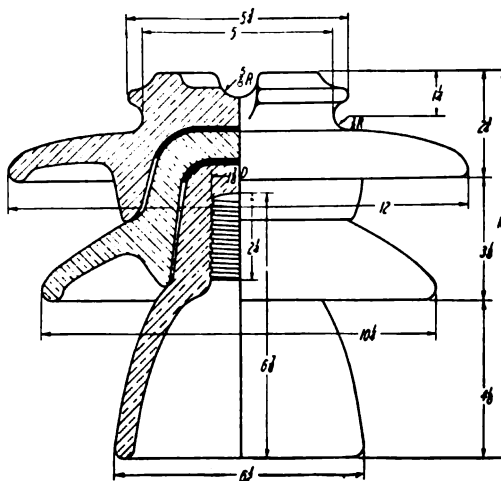
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

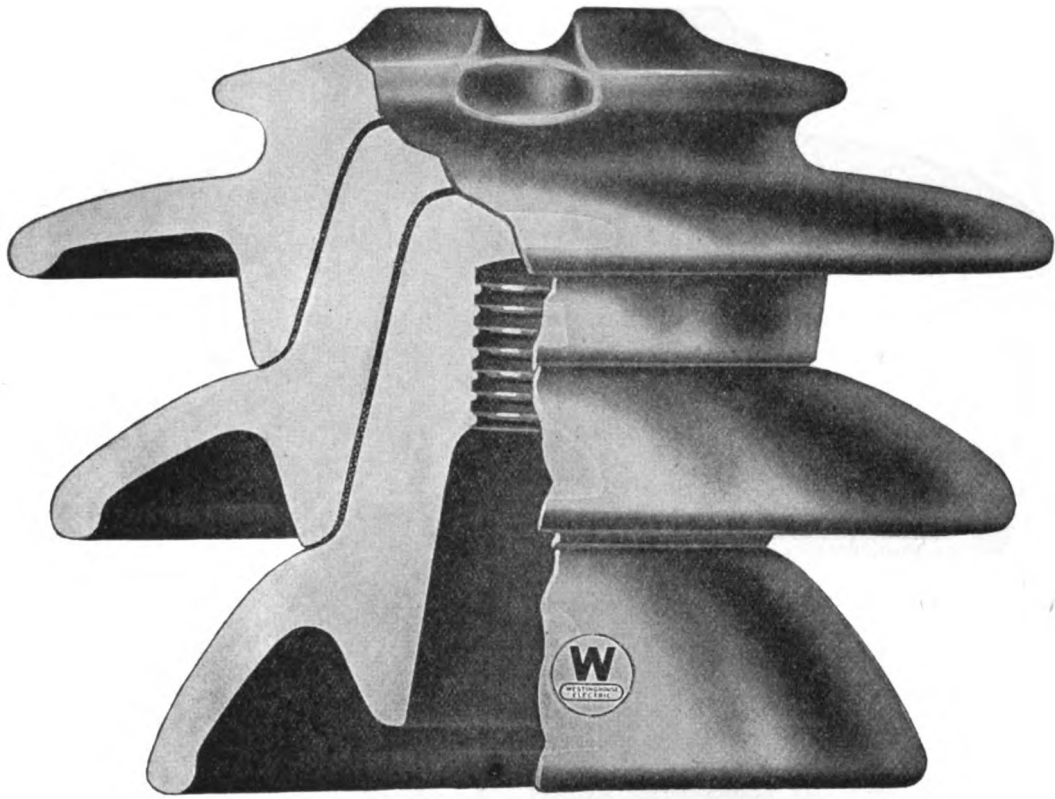
No. 3544

Trade voltage rating.....	50000
Dry arc-over voltage.....	155000
Leakage distance, inches.....	24½
Wet arcing distance, inches.....	7⅝
Diameter of insulator, inches.....	12
Height of insulator, inches.....	10
Diameter of top groove, inches.....	1¼
Size of pin hole, inches.....	1⅜
Approximate net weight per 100 in pounds...	2250
Approximate weight packed per 100 in pounds...	3400
Number per crate.....	3
Minimum pin height recommended.....	10 inches
List price per 100.....	\$642 00



13-121A

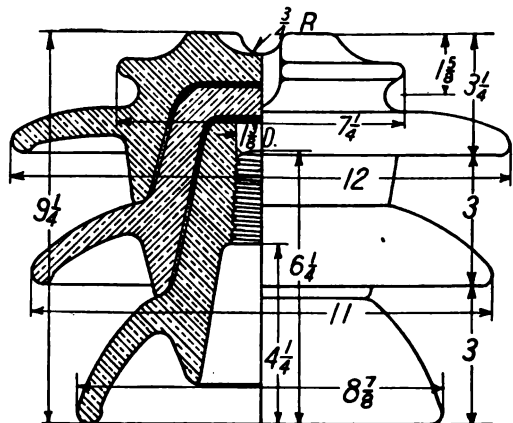
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

No. 3044

Trade voltage rating.....	50000
Dry arc-over voltage.....	160000
Leakage distance, inches.....	26 $\frac{1}{4}$
Wet arcing distance, inches.....	7 $\frac{5}{8}$
Diameter of insulator, inches.....	12
Height of insulator, inches.....	9 $\frac{1}{4}$
Diameter of top groove, inches.....	1 $\frac{1}{2}$
Size of pin hole, inches.....	1 $\frac{3}{8}$
Approximate net weight per 100 in pounds....	2900
Approximate weight packed per 100 in pounds.	4000
Number per open crate.....	3
Minimum pin height recommended.....	11 inches
List price per 100.....	<b>\$765 00</b>



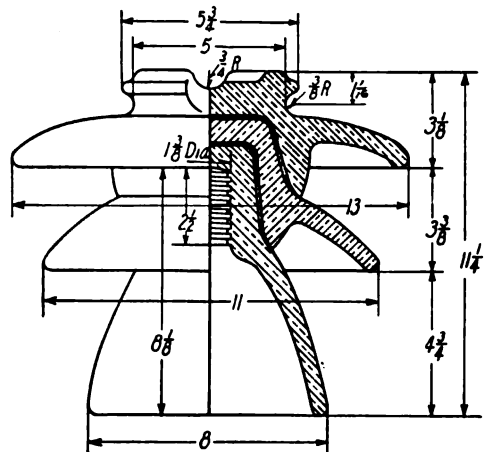
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

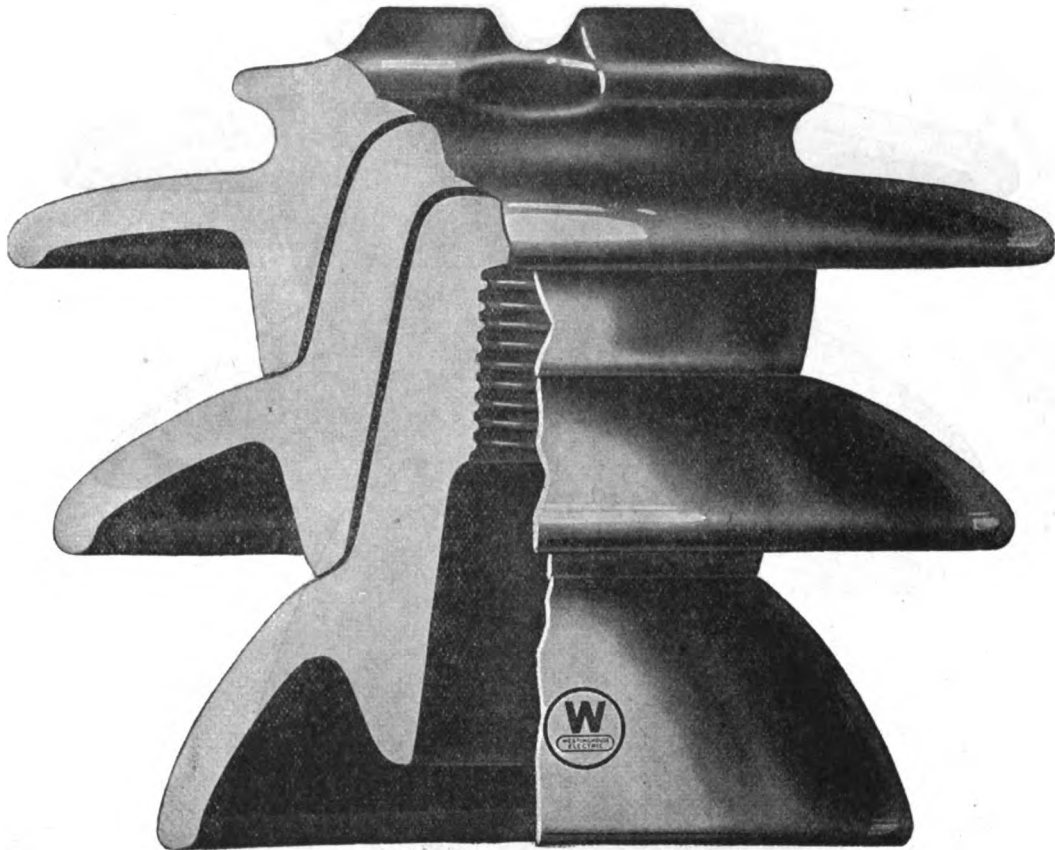
No. 3555

Trade voltage rating.....	60000
Dry arc-over voltage.....	180000
Leakage distance, inches.....	30
Wet arcing distance, inches.....	8½
Diameter of insulator, inches.....	13
Height of insulator, inches.....	11¼
Diameter of top groove, inches.....	1½
Size of pin hole, inches.....	1¾
Approximate net weight per 100 in pounds.....	2700
Approximate weight packed per 100 in pounds.....	3900
Number per crate.....	3
Minimum pin height recommended.....	12 inches
List price per 100.....	\$783 00



13-128A

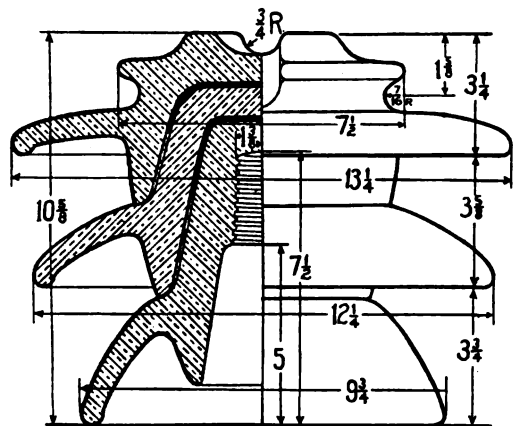
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

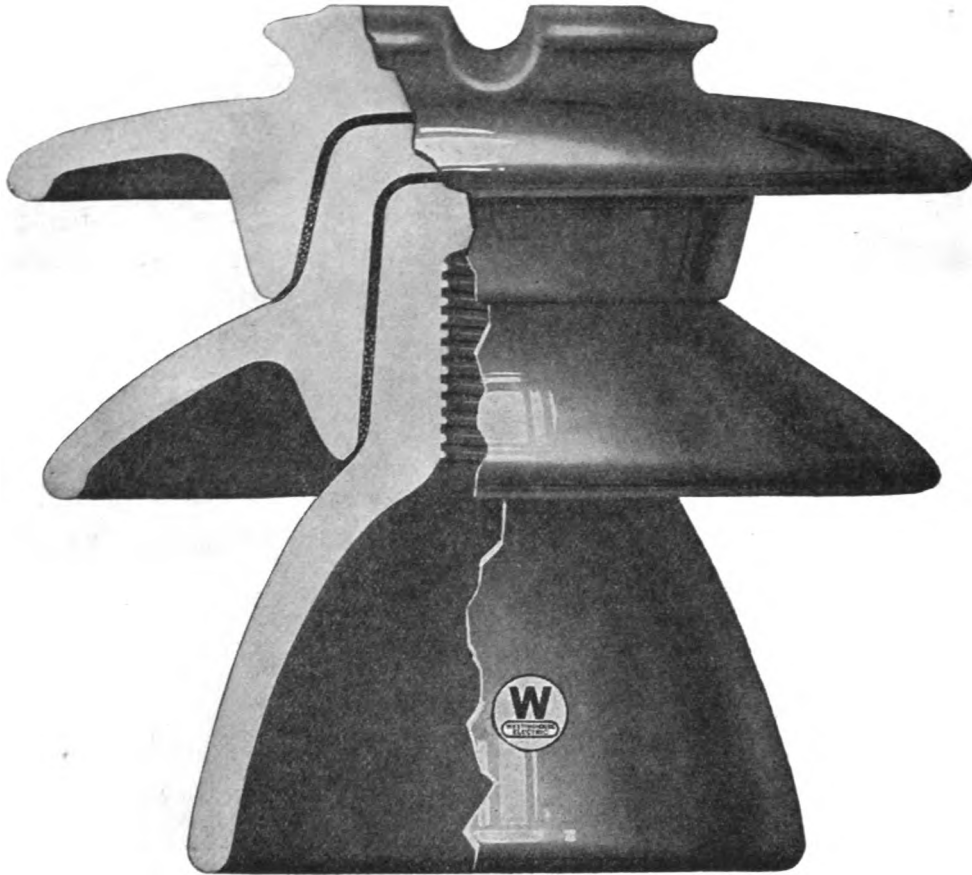
No. 3055

Trade voltage rating .....	60000
Dry arc-over voltage .....	180000
Leakage distance, inches .....	30 $\frac{1}{4}$
Wet arcing distance, inches .....	9 $\frac{1}{8}$
Diameter of insulator, inches .....	13 $\frac{1}{4}$
Height of insulator, inches .....	10 $\frac{5}{8}$
Diameter of top groove, inches .....	1 $\frac{1}{2}$
Size of pin hole, inches .....	1 $\frac{1}{8}$
Approximate net weight per 100 in pounds .....	3800
Approximate weight packed per 100 in pounds .....	4800
Number per open crate .....	3
Minimum pin height recommended .....	12 inches
List price per 100 .....	\$891 00



13-124A

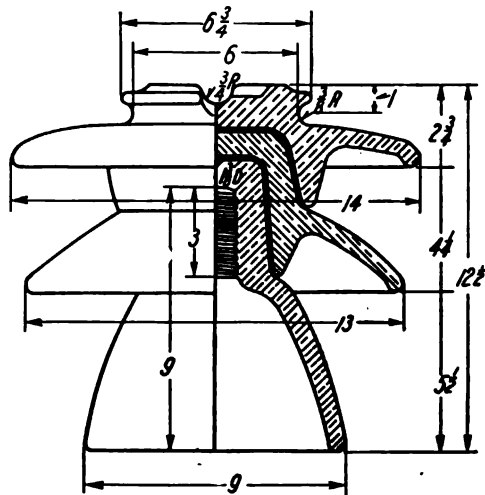
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

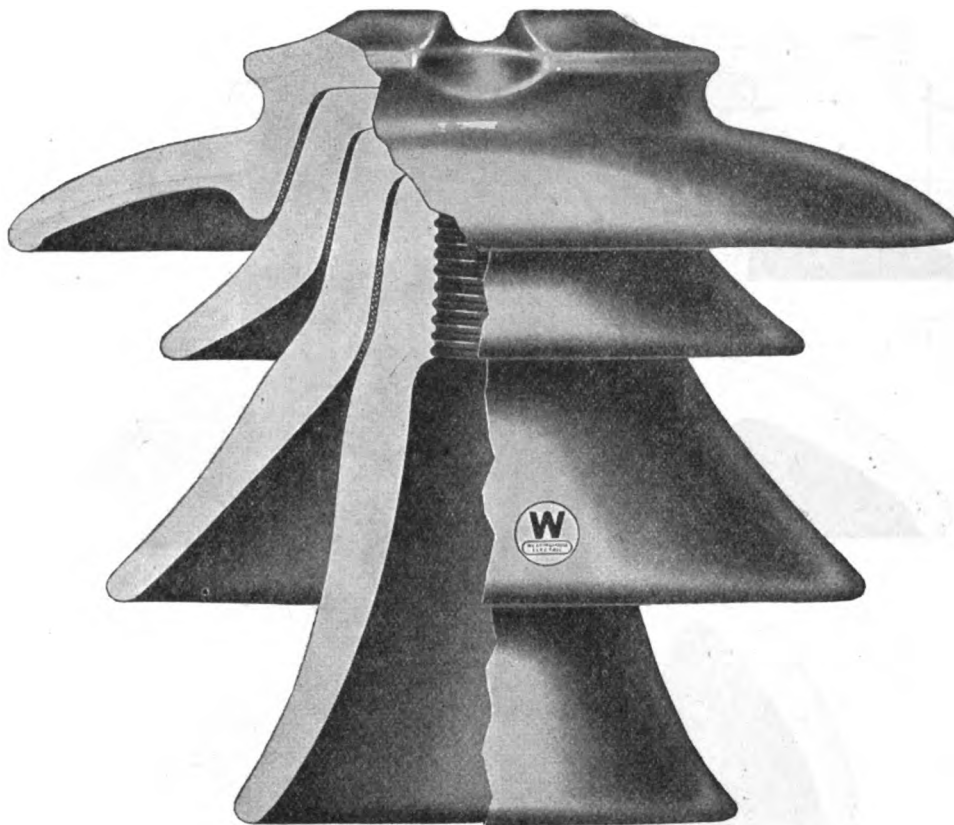
No. 3566

Trade voltage rating.....	70000
Dry arc-over voltage.....	200000
Leakage distance, inches.....	33½
Wet arcing distance, inches.....	10¼
Diameter of insulator, inches.....	14
Height of insulator, inches.....	12½
Diameter of top groove, inches.....	1½
Size of pin hole, inches.....	1⅜
Approximate net weight per 100 in pounds.....	3600
Approximate weight packed per 100 in pounds.....	4700
Number per crate.....	3
Minimum pin height recommended.....	13 inches
List price per 100.....	\$911 00



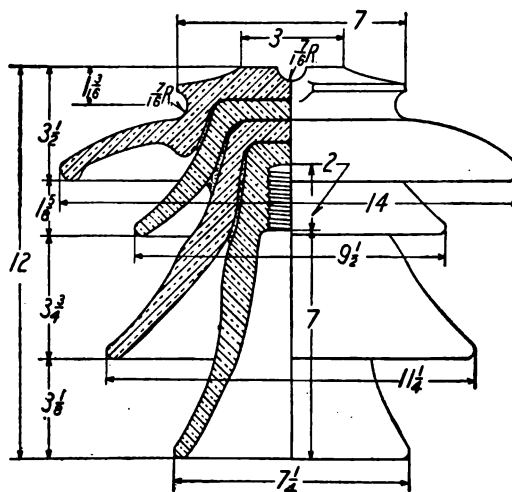
13-125A

PORCELAIN PIN-TYPE INSULATORS—Continued

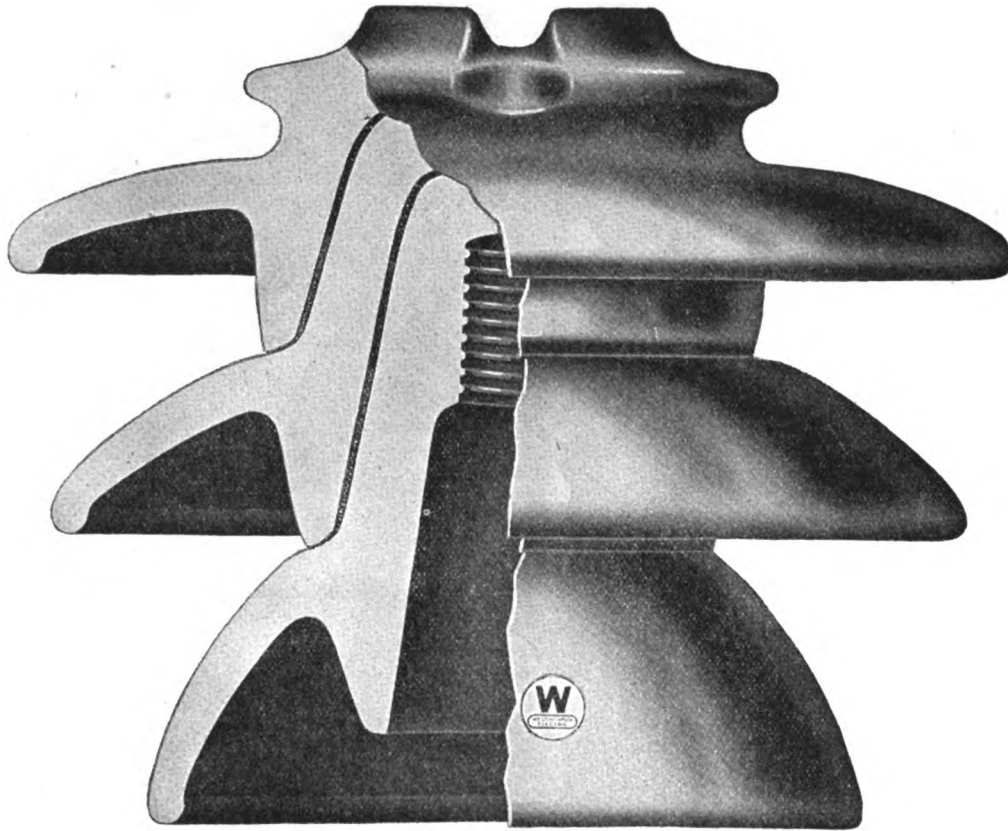


No. 4966

Trade voltage rating .....	70000
Dry arc-over voltage.....	185000
Leakage distance, inches.....	40 $\frac{3}{4}$
Wet arcing distance, inches.....	9 $\frac{7}{8}$
Diameter of insulator, inches.....	14
Height of insulator, inches.....	12
Diameter of top groove, inches.....	$\frac{7}{8}$
Size of pin hole, inches.....	1 $\frac{3}{8}$
Approximate net weight per 100 in pounds....	3700
Approximate weight packed per 100 in pounds.	4800
Number per crate.....	3
Minimum pin height recommended.....	13 inches
List price per 100.....	\$1093 00



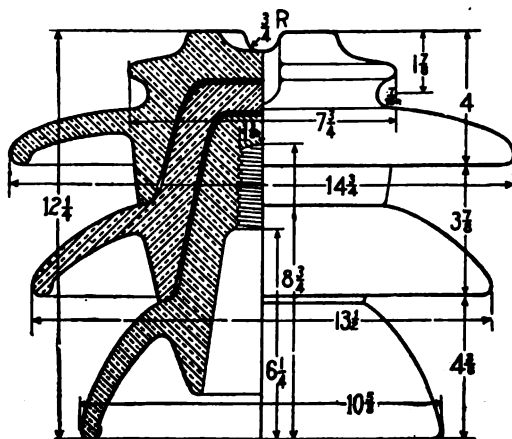
PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

No. 3066

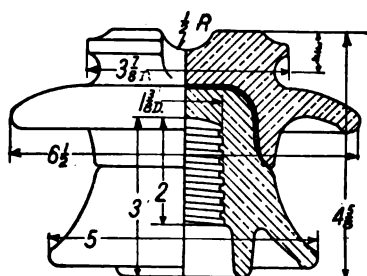
Trade voltage rating.....	70000
Dry arc-over voltage.....	205000
Leakage distance, inches.....	36½
Wet arcing distance, inches.....	10
Diameter of insulator, inches.....	14¾
Height of insulator, inches.....	12¼
Diameter of top groove, inches.....	1½
Size of pin hole, inches.....	1⅜
Approximate net weight per 100 in pounds....	4800
Approximate weight packed per 100 in pounds.	6300
Number per open crate.....	3
Minimum pin height recommended.....	14 inches
List price per 100.....	\$1161 00



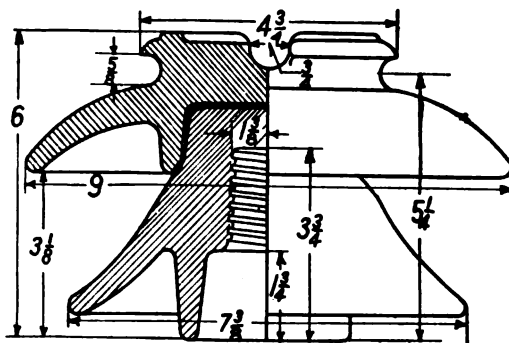
13-127A



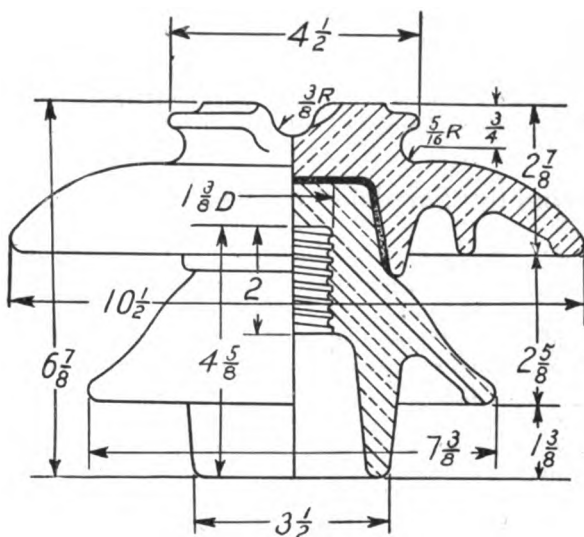
PORCELAIN PIN-TYPE INSULATORS—Continued



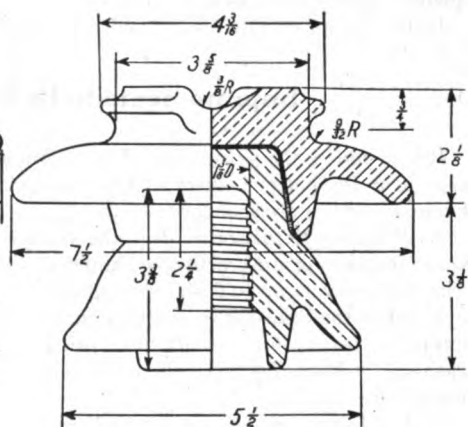
No. 2915



No. 2922



No. 2933



No. 2918

Insulator No.	2915	2918	2922	2933
Trade voltage rating	23000	27000	35000	45000
Dry arc-over voltage	75000	85000	100000	110000
Leakage distance, inches	8 3/4	12	16 1/2	20
Wet arcing distance, inches	3 5/8	4	5	6
Diameter of insulator, inches	6 1/2	7 1/2	9	10 1/2
Height of insulator, inches	4 5/8	5 1/4	6	6 7/8
Diameter of top groove, inches	1	3/4	3/4	3/4
Size of pin hole, inches	1 3/8	1 3/8	1 3/8	1 3/8
Approximate net weight per 100 in pounds	405	530	900	1150
Approximate weight packed per 100 in pounds	630	850	1330	1600
Number per package	45	36	6	6
Minimum pin height recommended	4 1/2 inches	5 1/2 inches	6 inches	7 inches
List price per 100	\$148 00	\$200 00	\$240 00	\$300 00

## PORCELAIN PIN-TYPE INSULATORS—Continued



TRADE **FARADOID** MARK  
PATENTED

**INSULATORS****11,000 to 66,000 Volts**

A study of present commercial types of insulators will show that most of them have been designed with some special qualities highly developed while other qualities have been neglected. One design has high puncturing strength, another high surface leakage, and so on. As a result, the weaker qualities have been causes of failure in service.

In the design of this line of high efficiency, pin

type insulators, each quality which might affect vitally durability in service has been given a degree of development that makes for uniformly effective insulators. All previous lack of uniformity in insulators has been due to the insulator manufacturer, who was not familiar with the modern principles of insulator design, which are based on a thorough knowledge of the dielectric field.

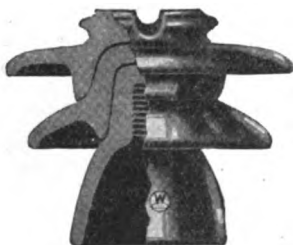
**Improvements to be Found in "Faradoid" Insulators**

Briefly stated, the advantages of the "Faradoid" type over the older commercial types in resisting failure in service are as follows:

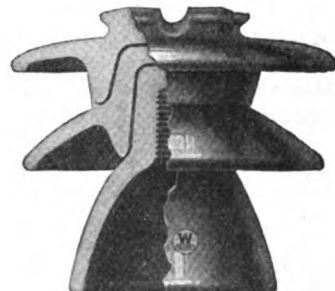
1. When the insulator is dry, the corona and static formations are practically limited to the tie wire and line wire up to flash-over voltage.
2. When the insulator is wet, no corona or static formation occurs up to flash-over voltage. The flash-over voltages for given overall dimensions are thereby increased.
3. The leakage resistance per shell is increased gradually from the head to the center shell. This takes into account the probability of the lower sheds becoming dirtier than the tops. The voltage distribution per shell is, therefore, equal when the insulator becomes dirty and wet and when a heavy leakage current passes over the insulator.
4. Since the capacity per shell is about equal, the voltage distribution per shell will be equal when the insulator is clean and in dry air.
5. Since the distribution of voltage per shell depends upon the capacity current and leakage current,

the distribution of voltage per shell in these designs should be approximately equal under all operating conditions.

6. The resistance of the insulator to side pull for a given weight and given electrical strength is relatively high. This is due to the design which causes the flow lines of the electrostatic field and the mechanical stress lines to coincide.
7. The design of the individual shells is such that when they are tested before assembly the surface conforms to the electrostatic flow lines. This allows testing of the individual parts at a closer approach to service voltage than was possible in case of the individual shells of older designs.
8. Due to the shape of individual parts and of the assembled unit, the insulator sheds when hit by stones, bullets, or balls, do not break beyond the insulating surface. The unit, therefore, offers a considerable percentage of its original resistance to flash-over even after the sheds are broken. The same feature tends to protect the insulator from complete failure during flash-over in service.

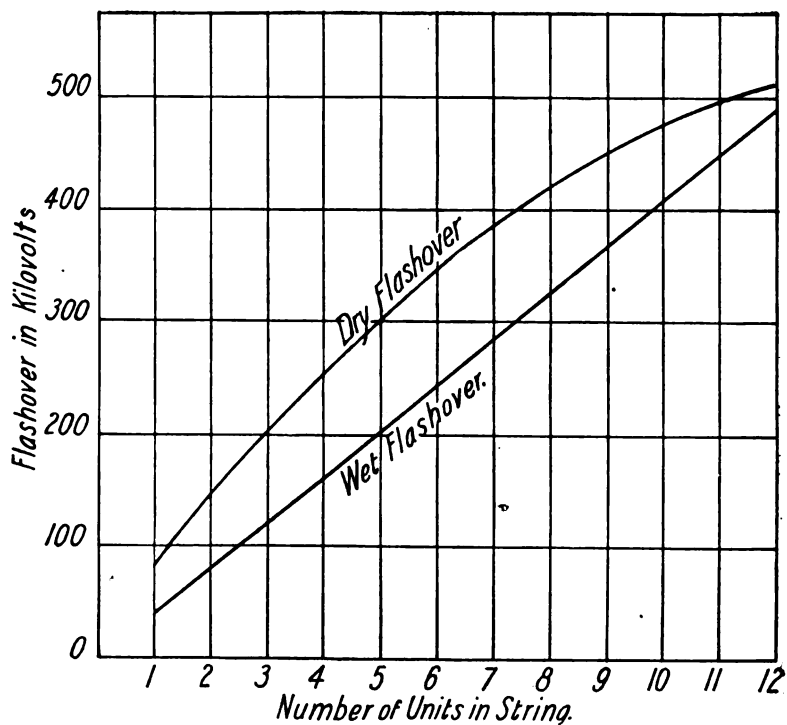


TRADE **FARADOID** MARK  
PATENTED

**INSULATORS**

**For characteristics of these insulators see their respective pages in this catalogue.**

## PORCELAIN SUSPENSION-TYPE INSULATORS



TYPICAL FLASHOVER VOLTAGE CURVES OF SUSPENSION-TYPE INSULATORS

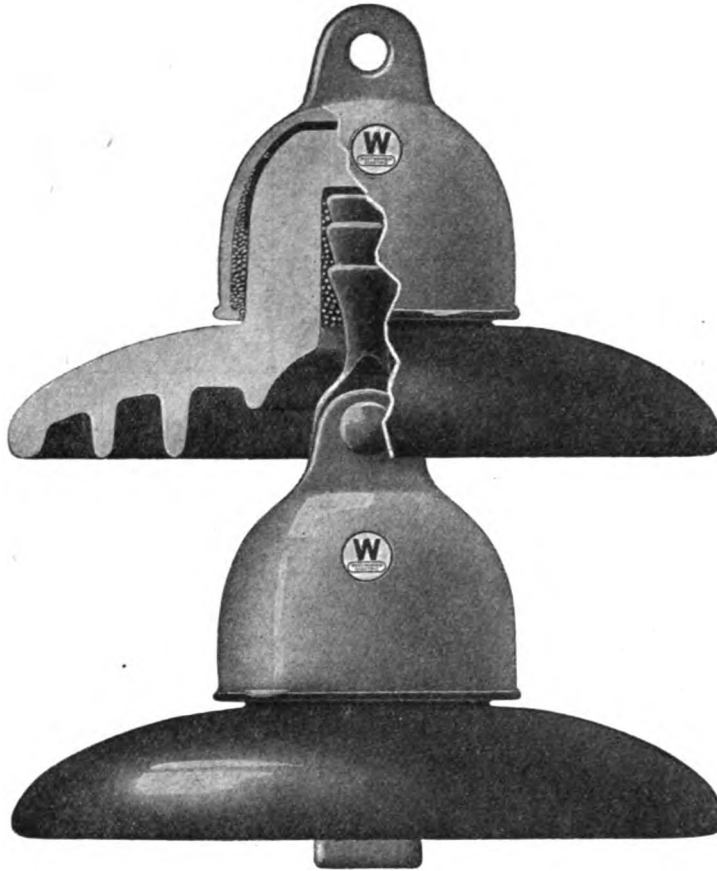
The standard ten-inch diameter suspension insulator is almost universally used on lines with voltages above 66,000 volts. The curves above indicate the variation of flashover voltages with the number of units in the string.

Practice varies with respect to the number of insulators installed for a given line voltage. The climatic conditions, the type of line construction, the continuity of service required, are but a few of the things which must be carefully considered. Our engineers, who have studied the maintenance of transmission lines, recommend the number of units

indicated in the following table. Their recommendations afford a high factor of safety under average conditions.

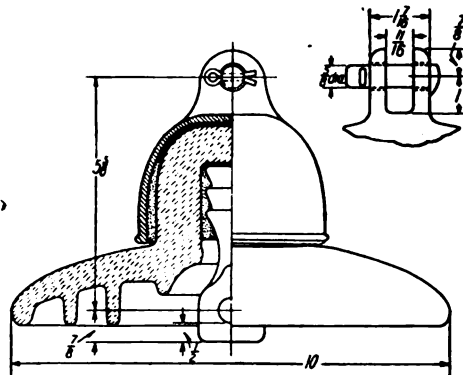
Line Voltage	Number of Units Recommended	
	Suspension	Strain
33,000 volts	2	3
44,000 volts	3	4
66,000 volts	5	6
88,000 volts	6	7
110,000 volts	8	9
132,000 volts	9	10
154,000 volts	10	11
220,000 volts	14	15

PORCELAIN SUSPENSION-TYPE INSULATORS—Continued



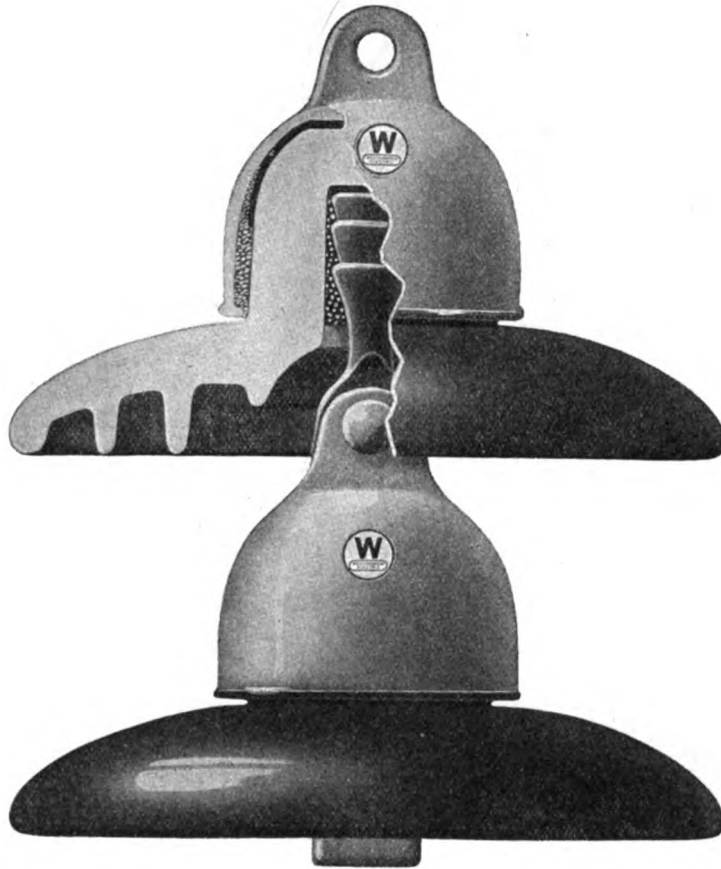
Two of Insulator No. 601

Insulator No. of one unit . . . . .	601
Trade voltage rating per unit . . . . .	20000
Dry arc-over voltage . . . . .	80000
Leakage distance, inches . . . . .	11½
Wet arcing distance, inches . . . . .	3¼
Diameter of insulator, inches . . . . .	10
Distance between center of eyes, inches . . . . .	5½
Approximate net weight per 100 in pounds . . . . .	1050
Approximate weight packed per 100 in pounds . . . . .	1335
Packed . . . 3, 4, 5, or 6 per crate as desired.	
List price per 100 units . . . . .	\$363 00



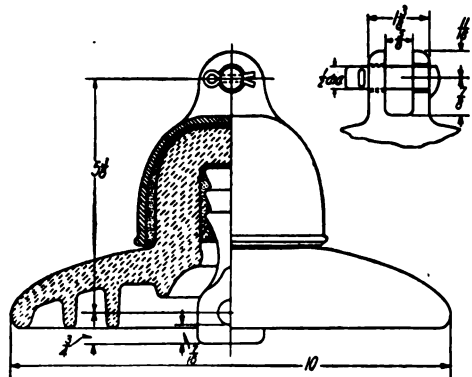
Note: For transmission line fittings refer to catalogue section 6-E.

PORCELAIN SUSPENSION-TYPE INSULATORS—Continued



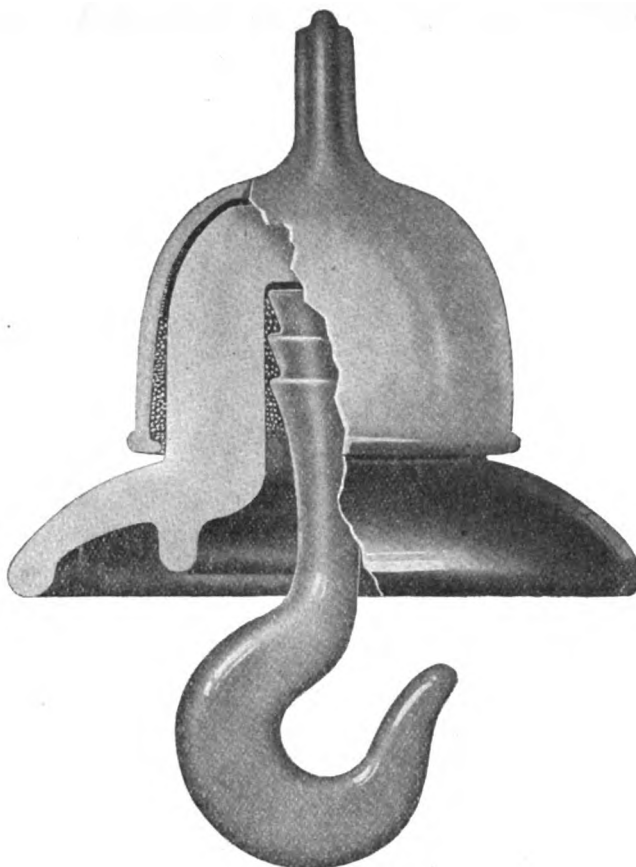
Two of Insulator No. 602

Insulator No. of one unit.....	602
Trade voltage rating per unit.....	20000
Dry arc-over voltage.....	80000
Leakage distance, inches.....	11½
Wet arcing distance, inches.....	3¼
Diameter of insulator, inches.....	10
Distance between center of eyes, inches.....	5⅝
Approximate net weight per 100 in pounds....	1050
Approximate weight packed per 100 in pounds.	1335
Packed....	3, 4, 5 or 6 per crate, as desired.
List price per 100 units.....	\$363 00



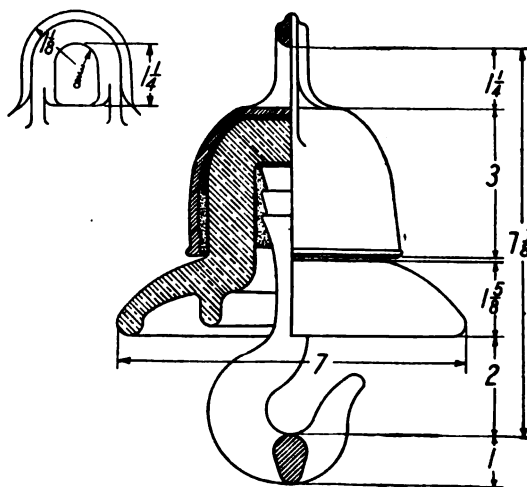
Note: For transmission line fittings refer to catalogue section 6-E.

SUSPENSION STRAIN INSULATORS—Continued



No. 621

Insulator No.....	621
Trade voltage rating per unit.....	11000
Dry arc-over voltage.....	65000
Leakage distance, inches.....	7
Wet arcing distance, inches.....	17/8
Diameter of insulator, inches.....	7
Distance between center of eyes, in.....	7 1/4
Approximate net weight per 100 in pounds.....	800
Approximate weight packed per 100 in pounds.....	1000
Number per package.....	18
List price per 100 units.....	\$342 00



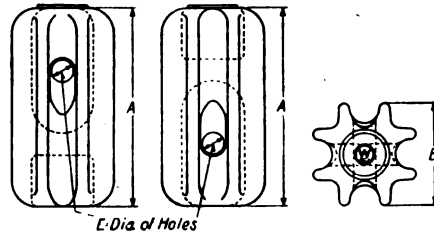
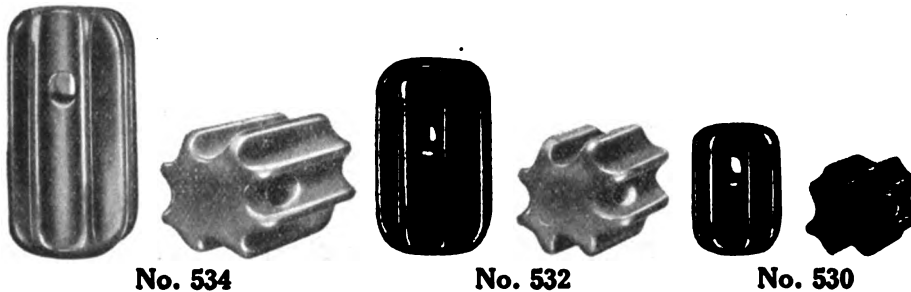
13-136A

## PORCELAIN STRAIN INSULATORS

Westinghouse porcelain strain insulators are made of a grade of porcelain much superior to that ordinarily used for such appliances. Sharp corners that would chip easily have been avoided and the shape of the grooves is such that the wires lie naturally in them. Long creepage distance between cables is provided.

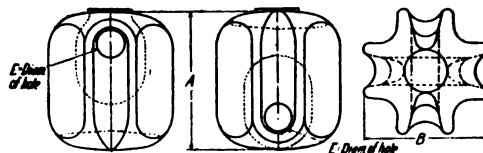
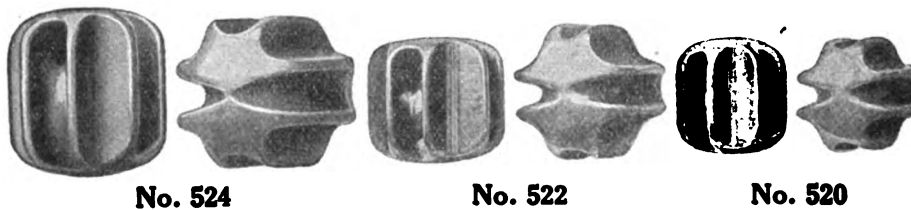
### FOR HIGH-VOLTAGE SERVICE

#### Type PS—Wet Process—Patented September 22, 1914



Insulator No.	Line Voltage	Dry Arc-over Voltage	DIMENSIONS, INCHES			No. per Bbl.	PER 100		List Price
			A	B	E		Net Wt., Lbs.	Wt., Packed Lbs.	
530	2400	30000	3 1/2	2 1/2	3/8	200	95	115	\$33 25
532	4400	40000	5 1/2	3 1/4	3/4	75	235	285	68 25
534	6600	45000	6 3/4	3 1/2	3/4	75	335	395	83 25
536	6600	45000	7	3 3/4	1	75	375	500	90 00

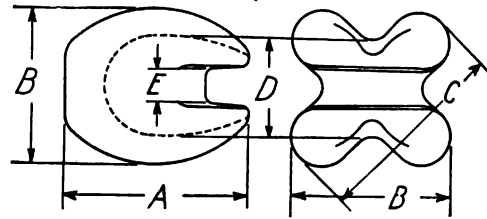
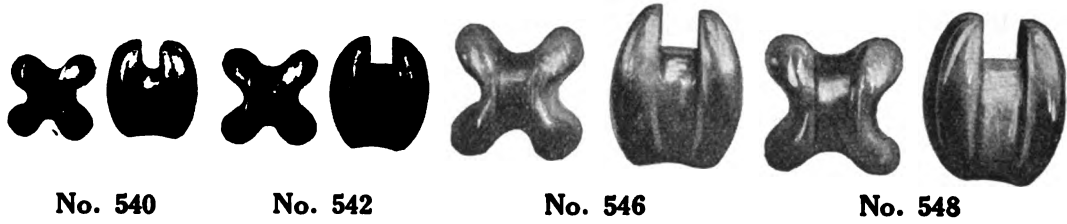
#### Type PG—Dry Process—Patented September 22, 1914



Insulator No.	Line Voltage	Dry Arc-over Voltage	DIMENSIONS, INCHES			No. Per Bbl.	PER 100		List Price
			A	B	E		Net Wt., Lbs.	Wt., Packed Lbs.	
520	2400	30000	3 3/8	3 1/4	1 1/2	200	165	195	\$33 25
522	3300	40000	3 7/8	4	5/8	125	225	305	68 25
524	3300	45000	5	4 1/2	1	75	400	475	83 25

PORCELAIN STRAIN INSULATORS—Continued

Type PN—Wet Process



These strain insulators are designed for applications which require the insulator to have unusually high mechanical and dielectric strengths.

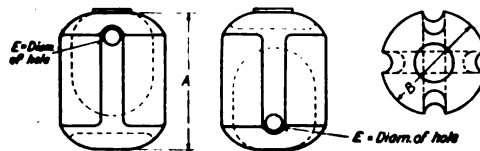
Insulator No.	Dry-Arc-over Voltage	DIMENSIONS, INCHES					No. Per Package	Per 100		List Price
		A	B	C	D	E		Net Weight Lbs.	Weight Packed Lbs.	
540	16,000	3½	3	3¾	1⅞	⅝	100	130	185	\$ 58 25
542	20,000	4	3⅝	4¼	2⅞	¾	100	155	210	125 00
546	25,000	5½	4⅝	5⅝	2⅞	1⅝	48	475	635	233 25
548	30,000	5¾	4⅝	6	3¼	1⅞	48	550	685	275 00



PORCELAIN STRAIN INSULATORS—Continued

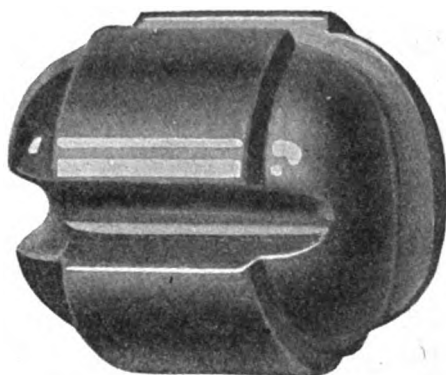
FOR LOW-VOLTAGE SERVICE

Type P-2—Dry Process

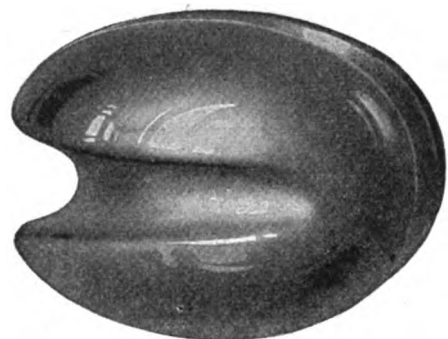


Insulator No.	DIMENSIONS, INCHES			No. Per Package	PER 100		List Price
	A	B	E		Net	LBS. Packed	
500	2 1/4	1 1/2	5/8	1100	25	31	\$10 00
502	3	2 3/8	9/8	300	70	85	21 75
504	3 3/4	2 3/4	5/8	200	125	150	26 75
506	5 1/2	3 3/8	3/4	100	300	365	50 00

BALL TYPE



Nos. 512 and 514



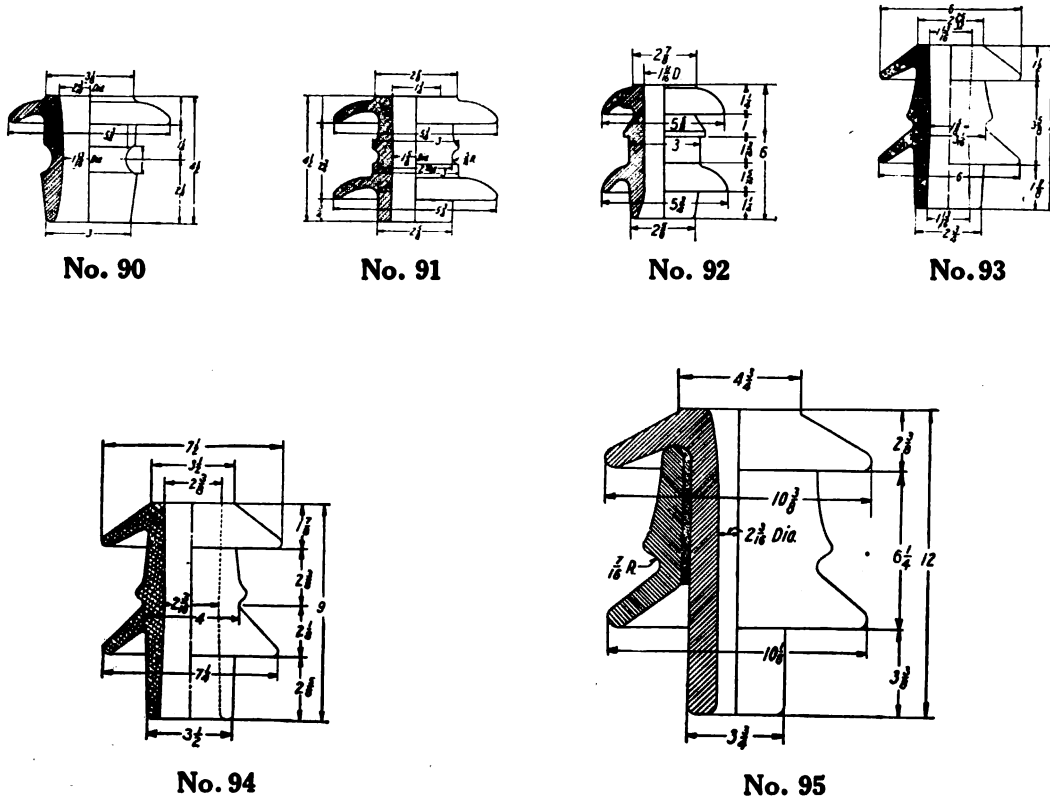
No. 516

Insulator No.	512	514	516
Diameter	2 1/4	2 3/4	3 1/4
Height	2 1/2	3 1/4	4 3/8
Diameter of groove	3/8	5/8	3/8
Package quantity	500	300	125
Approximate net weight per 100 in pounds	75	125	210
Gross weight, pounds, per 100	87	145	270
List price per 100	\$10 00	\$18 50	\$35 00

# PORCELAIN PIN-TYPE STRAIN INSULATORS

FOR VOLTAGES 6,600 to 22,000

High-voltage porcelain strain insulators are used at corners, curves, dead-ends, and similar points in transmission lines where the stress is too heavy for the ordinary pin-type insulator. For very high mechanical loads these may be installed in multiple.



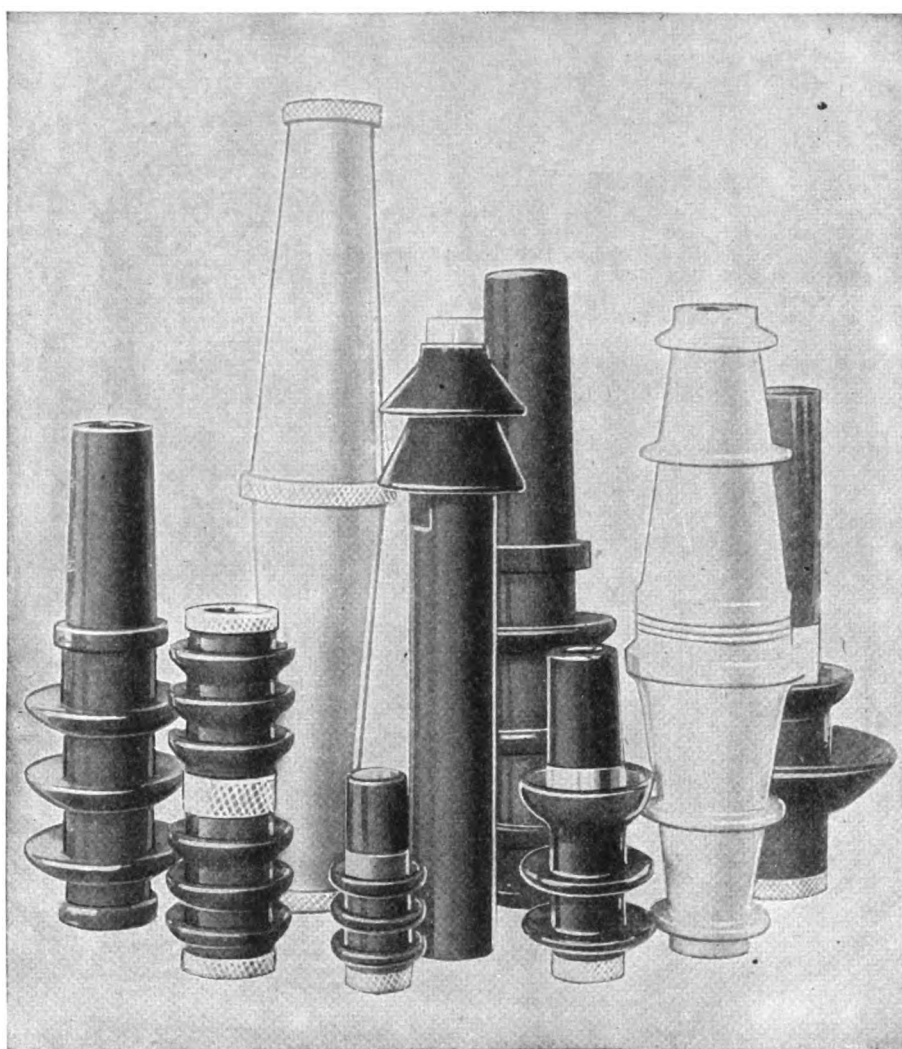
Insulator No.	VOLTAGE		Leakage Distance, Inches	Wet Arcing Distance, Inches	Package Quantity	PER 100		List Price
	Line	Dry Arc-over				APPROX. WT., LBS. Net	Packed	
90	6600	26000	2	...	60	250	360	\$143 00
91	7500	35000	5	1 5/8	50	275	395	263 00
92	10000	44000	5 1/2	1 3/4	40	360	500	240 00
93	11000	49000	6 1/2	2	27	500	800	383 00
94	15000	55000	8	2 1/4	10	800	1400	413 00
95	22000	67000	12 1/2	4	2	1925	4925	975 00

## PORCELAIN INSULATORS—SPECIAL DESIGNS

The great variety of electrical apparatus manufactured by the Westinghouse Electric and Manufacturing Company—circuit-breakers, lightning arresters, transformers, switches, fuses, etc.—requires many different kinds of both standard and special porcelain insulators. To take care of these wide and varied demands, the factory must have very complete facilities for manufacturing special porcelains by either the dry or wet process.

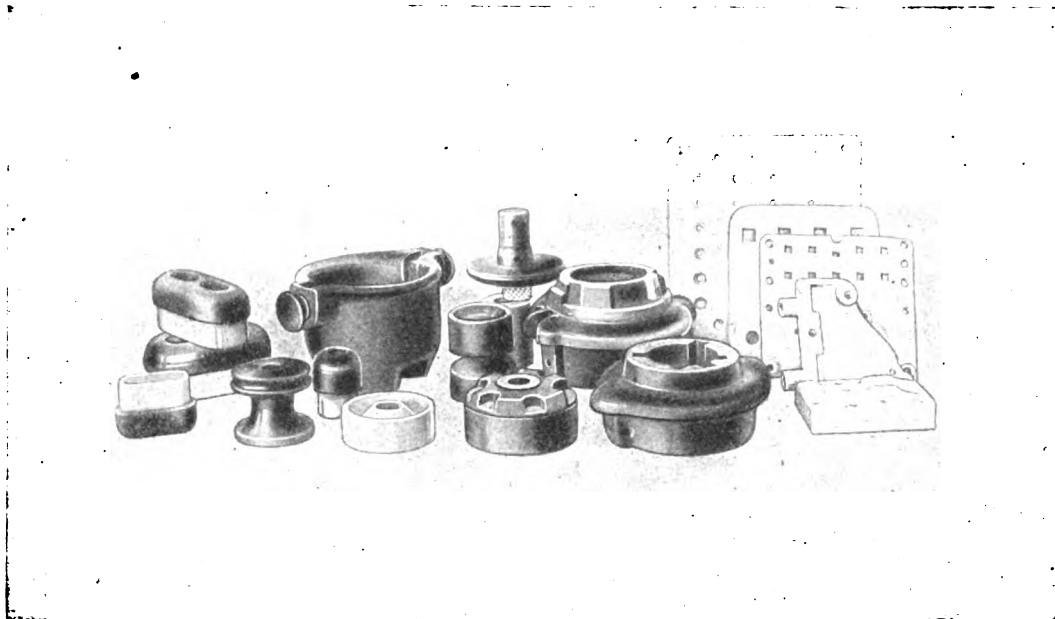
This places the Westinghouse Company in an especially advantageous position to give excellent service in the manufacture of special porcelains for others. Submit your drawings or sketches for estimates of cost or give us details regarding the application and we shall be pleased to offer suggestions for a suitable design.

The following illustrations show some of the various designs we are prepared to manufacture.

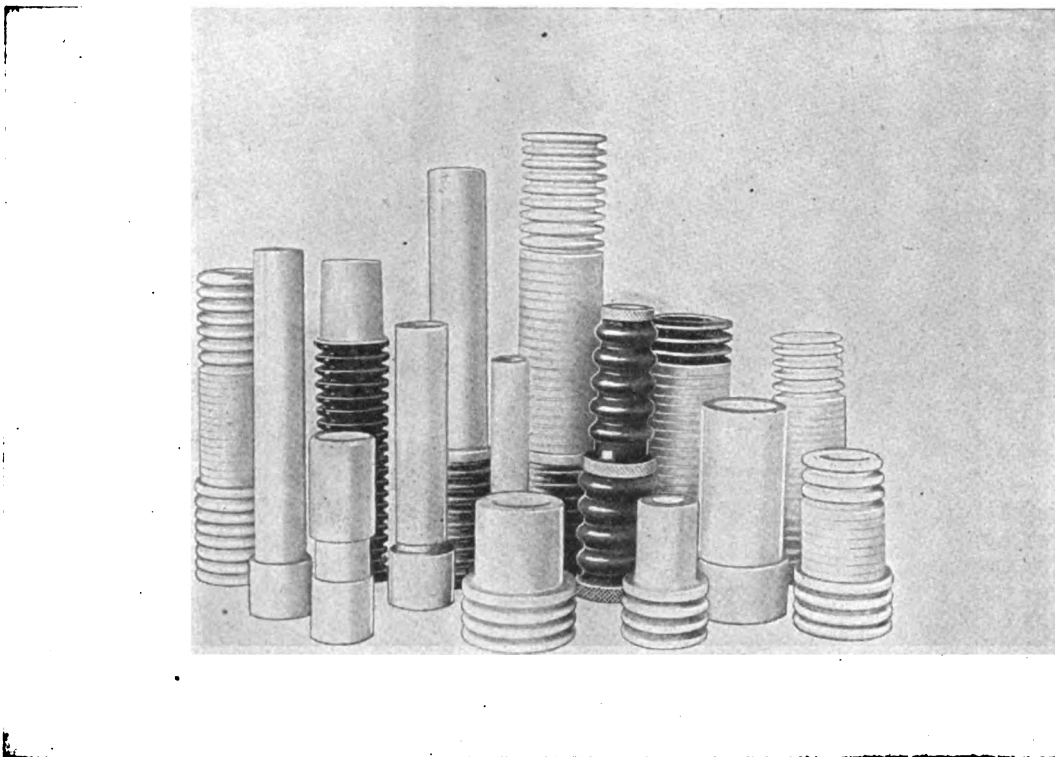


GROUP OF WET PROCESS BUSHINGS

PORCELAIN INSULATORS—SPECIAL DESIGNS—Continued

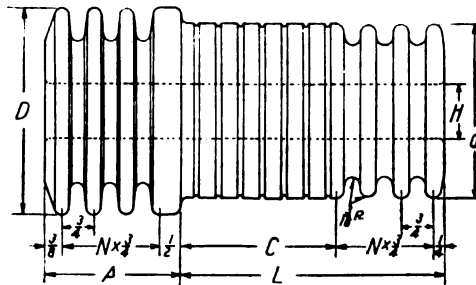


GROUP OF DRY PROCESS PORCELAIN DESIGNS



GROUP OF WET PROCESS TUBES AND SPECIAL DESIGNS

PORCELAIN WALL TUBES



OUTLINE DIMENSIONS

Insulator No.	H	D	d	A	*N	DIMENSIONS, INCHES											
						DIMENSION C OR THICKNESS OF WALL FOR L EQUAL TO											
						6	8	10	12	14	16	18	20	22			
Insulator No. ....	1 1/4	4 3/4	4	3	3	3 1/2	5 1/2	7 1/2	9 1/2	11 1/2	13 1/2	.....	.....	.....			
Insulator No. ....	1 1/4	4 3/4	4	3 1/2	4	2 3/4	4 3/4	6 3/4	8 3/4	10 3/4	12 3/4	14 3/4	.....	.....			
Insulator No. ....	1 1/4	4 3/4	4	4 1/2	5	2	4	6	8	10	12	14	.....	.....			
Insulator No. ....	1 1/4	4 3/4	4	6	7	.....	2 1/2	4 1/2	6 1/2	8 1/2	10 1/2	12 1/2	14 1/2	.....			
Insulator No. ....	1 1/4	4 3/4	4	7 1/2	9	.....	.....	3	5	7	9	11	13	15			
Insulator No. ....	2	5 1/2	4 3/4	3	3	3 1/2	5 1/2	7 1/2	9 1/2	11 1/2	13 1/2	.....	.....	.....			
Insulator No. ....	2	5 1/2	4 3/4	3 1/2	4	2 3/4	4 3/4	6 3/4	8 3/4	10 3/4	12 3/4	14 3/4	.....	.....			
Insulator No. ....	2	5 1/2	4 3/4	4 1/2	5	2	4	6	8	10	12	14	.....	.....			
Insulator No. ....	2	5 1/2	4 3/4	6	7	.....	2 1/2	4 1/2	6 1/2	8 1/2	10 1/2	12 1/2	14 1/2	.....			
Insulator No. ....	2	5 1/2	4 3/4	7 1/2	9	.....	.....	3	5	7	9	11	13	15			

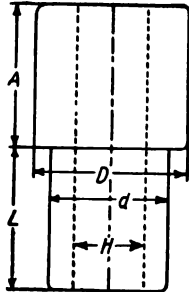
\*Number of corrugations.

PRICES (Per 100)

Insulator No.	List Price Per 100	Insulator No.	List Price Per 100	Insulator No.	List Price Per 100	Insulator No.	List Price Per 100
9000	355 00	9024	850 00	9050	411 00	9074	990 00
9001	436 00	9025	981 00	9051	511 00	9075	1146 00
9002	535 00	9026	1121 00	9052	626 00	9076	1303 00
9003	643 00	9031	585 00	9053	741 00	9081	883 00
9004	758 00	9032	700 00	9054	881 00	9082	808 00
9005	881 00	9033	816 00	9055	1023 00	9083	948 00
9010	378 00	9034	948 00	9060	445 00	9084	1105 00
9011	478 00	9035	1080 00	9061	551 00	9085	1281 00
9012	578 00	9036	1236 00	9062	666 00	9086	1435 00
9013	683 00	9037	1386 00	9063	800 00	9087	1618 00
9014	800 00	9042	783 00	9064	931 00	9092	908 00
9015	931 00	9043	915 00	9065	1088 00	9093	1083 00
9016	1083 00	9044	1046 00	9066	1236 00	9094	1220 00
9020	411 00	9045	1195 00	9070	486 00	9095	1393 00
9021	511 00	9046	1353 00	9071	593 00	9096	1583 00
9022	610 00	9047	1533 00	9072	708 00	9097	1781 00
9023	725 00	9048	1723 00	9073	850 00	9098	2005 00

## PORCELAIN FLOOR TUBES

### OUTLINE DIMENSIONS

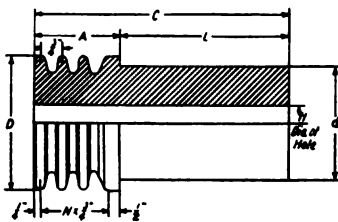


DIMENSIONS, INCHES				STYLE NUMBERS FOR L EQUAL TO											
H	D	d	A	3	4	5	6	8	10	12	14	16	18	20	
3/4	2 1/2	1 3/4	3	9100	9101	9102	9103	9104	9105	9106	9107	9108	.....	.....	
1	2 3/4	2	3	9110	9111	9112	9113	9114	9115	9116	9117	9118	.....	.....	
1 1/4	3	2 1/4	3	.....	9120	.....	.....	.....	.....	.....	.....	.....	.....	.....	
1 1/2	3 1/4	2 1/2	3	.....	.....	9130	.....	.....	.....	.....	.....	.....	.....	.....	
1 3/4	3 1/2	2 3/4	3	.....	.....	.....	9140	9141	9142	9143	9144	9145	9146	.....	
2	3 3/4	3	3	.....	.....	.....	9150	9151	9152	9153	9154	9155	9156	.....	
2 1/2	4 1/2	3 1/4	3	.....	.....	.....	9160	9161	9162	9163	9164	9165	9166	.....	
3	5	4 1/4	3	.....	.....	.....	.....	9170	9171	9172	9173	9174	9175	9176	

### PRICES (Per 100)

Insulator No.	List Price per 100	Insulator No.	List Price per 100	Insulator No.	List Price per 100	Insulator No.	List Price per 100
9100	\$123 00	9116	\$428 00	9134	\$470 00	9155	\$ 718 00
9101	140 00	9117	511 00	9135	560 00	9156	833 00
9102	156 00	9118	593 00	9136	651 00	9160	338 00
9103	205 00	9120	173 00	9137	741 00	9161	411 00
9104	283 00	9121	190 00	9140	271 00	9162	503 00
9105	321 00	9122	255 00	9141	346 00	9163	610 00
9106	386 00	9123	313 00	9142	411 00	9164	718 00
9107	453 00	9124	378 00	9143	495 00	9165	833 00
9108	535 00	9125	453 00	9144	585 00	9166	985 00
9110	140 00	9126	535 00	9145	685 00	9170	370 00
9111	156 00	9127	618 00	9146	791 00	9171	461 00
9112	173 00	9130	205 00	9150	288 00	9172	560 00
9113	238 00	9131	271 00	9151	363 00	9173	680 00
9114	296 00	9132	330 00	9152	428 00	9174	791 00
9115	363 00	9133	395 00	9153	528 00	9175	923 00
				9154	618 00	9176	1068 00

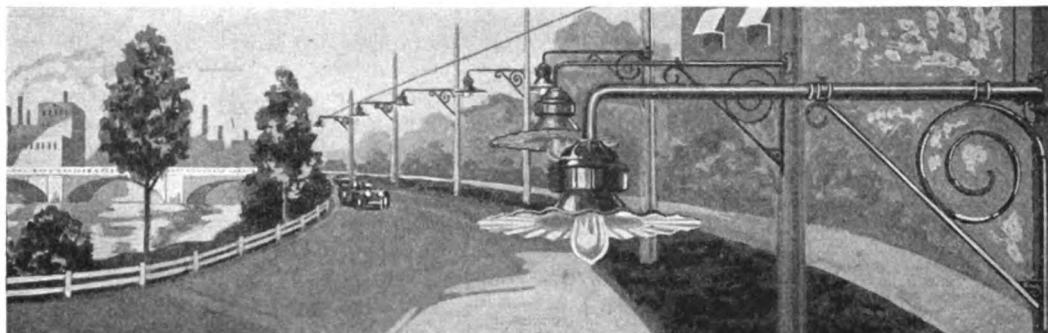
## PORCELAIN TUBES



Insulator No.	DIMENSIONS, INCHES						*N	List Price per 100
	H	D	C	d	A	L		
9200	1 1/4	4 1/4	7	3	3	4	3	\$ 213 00
9201	1 1/4	4 1/4	12 1/2	3	4 1/2	8	5	461 00
9202	1 1/4	4 1/4	18	3	6	12	7	733 00
9203	1 1/4	4 1/4	23 1/2	3	7 1/2	16	9	1071 00
9210	2	5	7	3 3/4	3	4	3	248 00
9211	2	5	12 1/2	3 3/4	4 1/2	8	5	535 00
9212	2	5	18	3 3/4	6	12	7	848 00
9213	2	5	23 1/2	3 3/4	7 1/2	16	9	1253 00

\*Number of corrugations.

## MODERN STREET LIGHTING SYSTEMS WITH CUTTER STREETHOODS



The methods employed for operating street lighting systems of type C incandescent lamps may be divided into two classes: Multiple and Series Operation.

**Multiple systems** are usually operated at 110 or 220 volts, supplied from an ordinary constant potential distribution transformer. This system has been generally used for very small installations where the distance traversed by line wires is not sufficiently great to warrant the use of the regulating equipment required for a series system.

**Series systems**, using one conductor to traverse the lighted area, as compared with two conductors for the Multiple system, are used on all installations where the expense of regulating equipment is offset by the saving in power losses and cost of conductors. The Series system is usually more economical; but for very small installations where complete regulating apparatus would be required, it may be found more practical to install Multiple lamps, although certain variations of the Series system described below are particularly applicable to small installations.

### METHODS OF OPERATION OF SERIES DISTRIBUTION SYSTEMS

There are several methods of using Series incandescent lamps in Cutter Streethoods, viz.:

1. The Constant Current Straight Series System, using a Film socket with each lamp. In the event of lamp failure, the calibrated film in the socket punctures under the full line voltage and re-establishes the circuit instantly. The system is operated through a moving coil regulating transformer of either the pole mounted type controlled by a time switch, or the station type with manually operated control panel. The regulator takes care of changes in the load and maintains a uniformly constant current. This method is suitable for all Series systems employing lamps ranging from 400 to 6000 lumens.

2. The Series system using an individual two-winding transformer or safety coil placed on the pole from which the service wires lead to the fixture. The transformer primaries are connected in series and each secondary delivers the correct amount of current at the rated lamp voltage. Multiple Streethoods are used. The system is usually supplied through a regulating transformer. In many cases the safety coils are placed on the

same circuit with fixtures equipped with film sockets as outlined above. This method is particularly applicable to installations of Series lamps of 4000 lumen rating or larger, and has the special feature of providing a low potential in the line wires from transformer to fixture.

3. The Constant Potential Series system using a Multiple socket and a shunt or reactance coil with each lamp. This system is usually supplied by an adjuster-socket transformer which is provided with a number of extra taps to obtain the correct circuit voltage. When a lamp fails, the reactance of the shunt coil automatically maintains the proper current. This system is used on small installations of 2500 lumen lamps or smaller where the total circuit capacity is two kilowatts or less. Adjuster-socket Streethoods are used.

Local conditions govern the selection of the method of operation of a series distribution system. If complete data is given on the number and size of lamps, plan of streets, central station equipment and methods of distribution now used, our Illuminating Engineering Bureau will make recommendations for the most efficient and suitable method of distribution.

## SERIES SYSTEMS

### CONSTRUCTION OF CUTTER SERIES STREETHOODS

The design of Cutter Streethoods is the result of many years of experience in the development of street lighting equipment. Every detail of their construction has been planned to meet the most exacting requirements of series lighting systems. They are easily installed and wired. They give long and efficient service. To meet the varied conditions which obtain in up-to-date installations, a number of interchangeable parts are available for assembly into a great number of combinations.

A Streethood consists primarily of a porcelain head with socket and canopy, together with a reflector. Various types of suspension fittings become a part when required. Different types of glassware are used with reflectors to obtain any desired form of light distribution.

In Cutter Series Streethoods, the porcelain head and socket are built as a compact unit. The construction is such as to provide high dielectric as well as mechanical strength. Wire terminals or binding posts are so arranged that wires can be very easily connected, whether the fixture is inner or outer wired. Three screws in each binding post clamp

the wire in place and provide good electrical contact. Outside wires enter at an upward angle, to prevent water from entering the fixture. When outer wiring is used, the wires may be tied to lugs provided on the outside of the head, making the use of a cross-arm unnecessary. These lugs are so arranged that the leading in wires are held at the greatest possible distance from the canopy. Each porcelain head is equipped with an iron reflector supporting ring, which grips and locks the reflector.

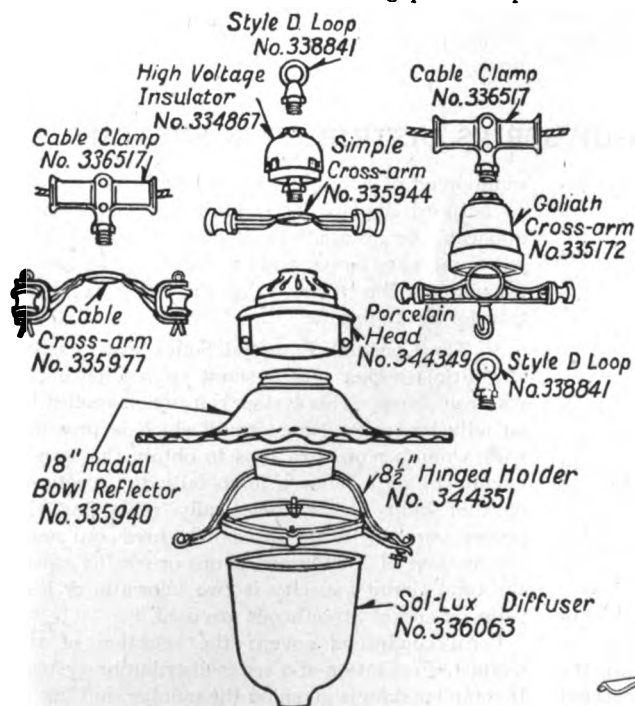


CUTTER STREETHOOD REFLECTOR, SHOWING COPPER HEEL AND BEADED EDGE

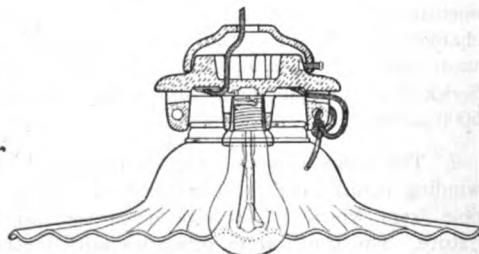
It is so arranged that reflectors can be installed or removed by the adjustment of only one screw. This screw is so arranged, however, that the weight of the reflector and glassware does not rest upon it. All iron parts are heavily galvanized and painted with black enamel.

Canopies are secured in place by large screws bearing in lead slugs imbedded in the porcelain. The top of the canopy is cast hexagonal in shape, which facilitates installation, and is threaded for both  $\frac{3}{4}$  and  $1\frac{1}{4}$ -inch pipe.

Reflectors are made of deep drawing steel. During the manufacturing process the edge is beaded over and corrugated. Three coats of enamel on the



INTERCHANGEABLE PARTS FOR SERIES CENTER-SUSPENSION STREETHOODS



METHOD OF WIRING CUTTER SERIES STREETHOODS



## SERIES SYSTEMS—Continued

## CONSTRUCTION OF CUTTER SERIES STREETHOODS—Continued

exterior, as well as three coats on the interior are lapped over the beaded edge forming a protective covering that is extremely durable. The enamel used on the under surface is a reflective white of high efficiency.

A copper heel is spun in place at the top to prevent chipping of the enamel from contact with clip or screw supports. When reflectors are held by any other means, the enamel is easily chipped and corrosion starts. Reflectors are so shaped that they shed rain, sleet and snow, thus providing maximum protection for the lamp and relieving the fixture of undue strain.

Glassware is supported independently of the reflector proper. The holder is so arranged that it is secured to the heel of the reflector and held in place by the same screw. The holder is arranged with hinges, so that the glassware may be easily lowered for cleaning purposes and the lamps may be easily replaced.

Where it is desired to secure a broader light distribution, the Holophane Superlux refractor is recommended. This refractor is of the latest design, and represents the result of many years' study of refracting glassware when used in connection with street-hood lighting. Skirted reflectors and Sol-Lux diffusers are used when modifications of the broad distribution of light are required.

The Holophane Superlux refractor consists of two pieces of pressed crystal glass, nested one within the other and clamped together so as to form a single unit. The inside surface of the inner piece and the outside surface of the outer piece are smooth; so that in the assembled unit, both inside and outside surfaces are smooth, making cleaning easy. The outside surface of the inner piece has horizontal prisms so designed as to bend downward the upward emitted light and to bend upward a part of the light emitted downward. The light emitted downward near the vertical, is redistributed to give a good distribution under the unit. This arrangement of horizontal prisms greatly increases the light emitted at angles of 60-degrees to 85-degrees with the vertical and hence greatly extends the radius of effective illumination, but at the expense of the light which would naturally fall directly under the unit. The inside surface of the outside piece has vertical flutes which, while not materially altering the distribution produced by the inside piece diffuse the light and greatly reduce the brilliancy from that of the unshielded filament.

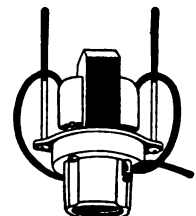
Film sockets are used in all series streethoods. Their advantages are fully outlined on pages 828 and 830.

REGENT C  
PORCELAIN HEADREGENT C  
LAMP HOLDER**Regent C Series Streethoods**

Regent C series streethoods consist of the Regent C porcelain head and Regent C film socket built up as a compact unit. All of the various interchangeable parts are available as listed on succeeding pages.

STANDARD  
PORCELAIN HEADSTANDARD  
FILM SOCKET**Standard Series Streethoods**

Standard series streethoods are made up with the porcelain head and standard film socket constructed as a single unit. The various interchangeable parts are available as listed on the following pages.

ADJUSTER SOCKET  
PORCELAIN HEAD  
WITH SKIRTREACTANCE COIL  
AND SOCKET**Adjuster Socket Streethoods**

Adjuster socket streethoods are made up of the Universal porcelain head, to which is added a cast iron skirt to provide sufficient clearance for the shunt coil or reactance coil and mogul multiple socket. The socket and coil, together with the skirt, porcelain head and canopy, are completely assembled into one unit, with which the various types of suspension fitting, reflectors and glassware are used.

SERIES SYSTEMS—Continued

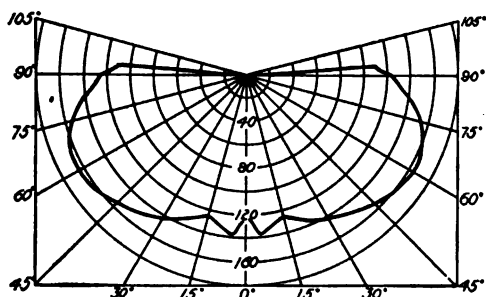
EFFICIENT ILLUMINATION WITH CUTTER SERIES STREETHOODS

The first consideration in the selection of every street-lighting fixture is the amount of light required; that is, the size of lamp. The next consideration is the manner in which the light should be distributed. These determine one or two styles of Streethood Reflectors. The third consideration, that of the method of installation, will enable the customer to select the one best suited to his requirements. Cutter Streethoods and the brackets for supporting them are listed separately. The

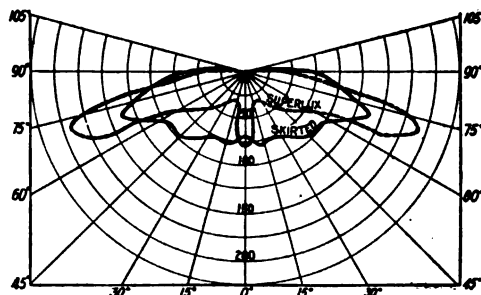
size of lamp in lumens is given for each Streethood which enables the selection of the one best suited to the lighting needs. The Streethood may then be offered in combination with several styles of brackets and center-suspension parts. Thus a complete fixture may be assembled to suit any condition.

To facilitate proper selection of Streethoods typical distribution curves for type C lamps with each reflector are shown below.

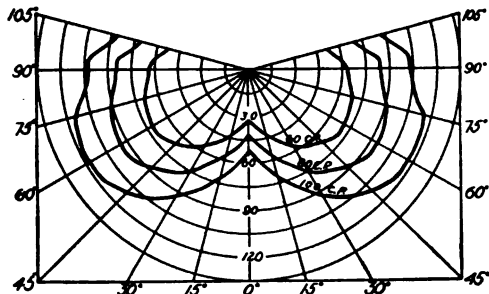
Distribution Curves



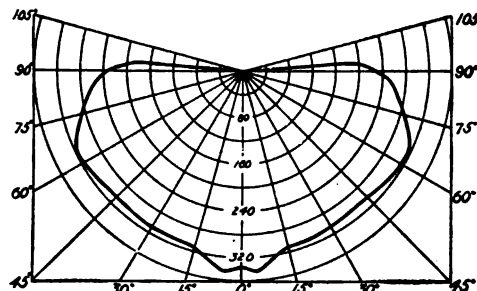
DISTRIBUTION CURVE OF 1000-LUMEN TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR



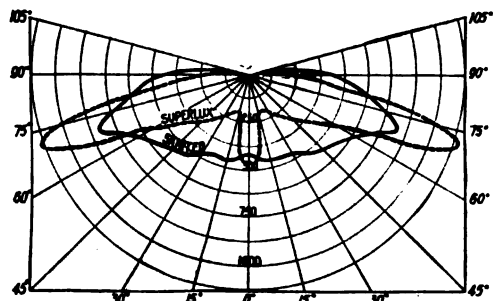
DISTRIBUTION CURVES OF 1000-LUMEN TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR AND 6 1/4-INCH HOLOPHANE SUPERLUX AND SKIRTED REFRACTORS



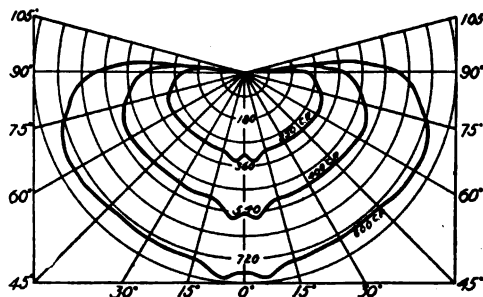
DISTRIBUTION CURVES OF 600, 800 AND 1000-LUMEN TYPE C LAMPS WITH 20-INCH FLAT RADIAL REFLECTOR



DISTRIBUTION CURVE OF 2500-LUMEN TYPE C LAMP WITH 20-INCH RADIAL BOWL REFLECTOR WITH EXTENSION



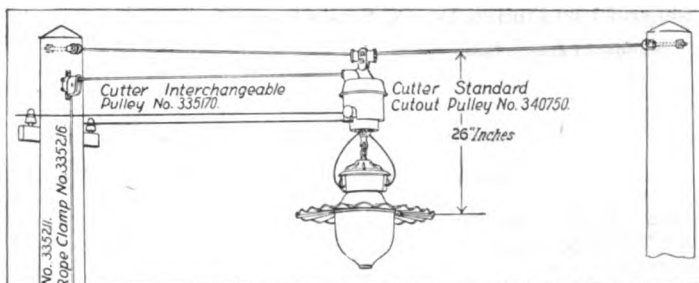
DISTRIBUTION CURVES OF 6000-LUMEN TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR AND 8 1/4-INCH HOLOPHANE SUPERLUX AND SKIRTED REFRACTORS



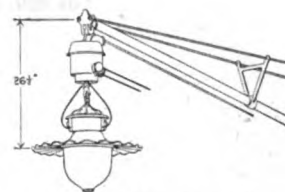
DISTRIBUTION CURVES OF 2500, 4000 AND 6000-LUMEN TYPE C LAMPS WITH 18-INCH RADIAL BOWL REFLECTOR AND SOL-LUX DIFFUSER

SERIES SYSTEMS—Continued

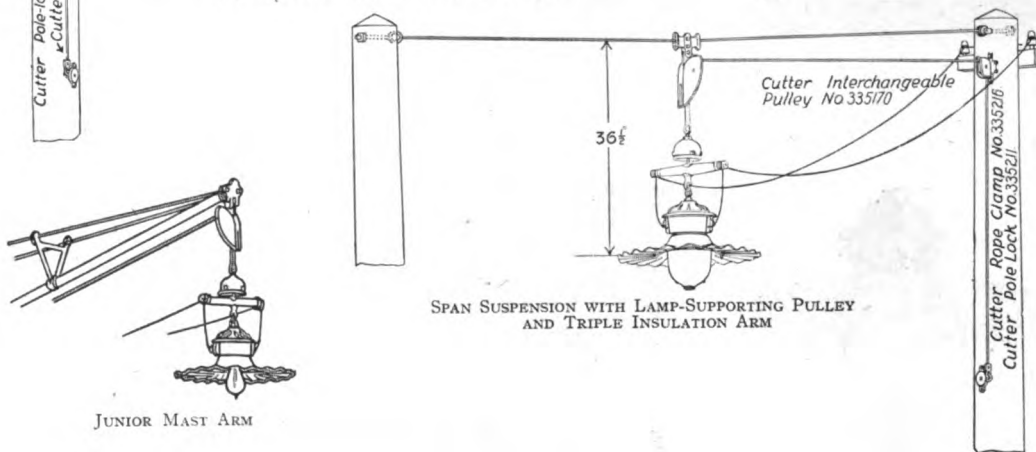
APPLICATIONS OF SUSPENSION FITTINGS



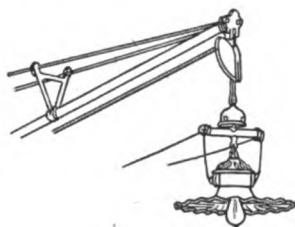
SPAN SUSPENSION WITH CUTOUT PULLEY



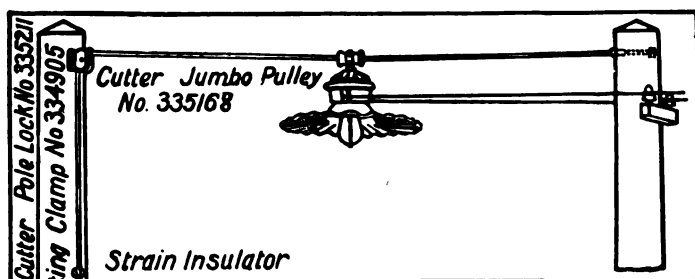
JUNIOR MAST ARM WITH STANDARD CUT-OUT PULLEY



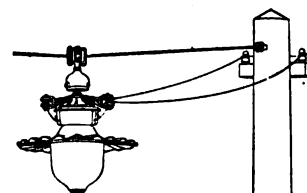
SPAN SUSPENSION WITH LAMP-SUPPORTING PULLEY AND TRIPLE INSULATION ARM



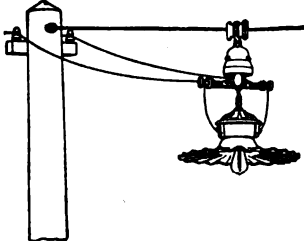
JUNIOR MAST ARM



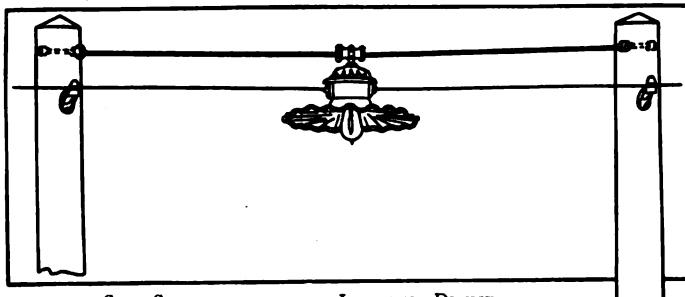
SPAN SUSPENSION WITH SPAN WIRE ARRANGED FOR LOWERING OVER POLE PULLEY



REGENT C SERIES STREETHOOD WITH 18-INCH RADIAL BOWL REFLECTOR AND 8 1/2-INCH HOLOPHANE SUPERLUX REFRACTOR



REGENT C SERIES STREETHOOD WITH 18-INCH RADIAL BOWL REFLECTOR



SPAN SUSPENSION WITHOUT LOWERING DEVICE

## SERIES SYSTEMS—Continued

## REGENT C SERIES STREETHOODS

## Bracket Type

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*

Standard Package Quantity 10



## Description

Style No.

Ship. Wt.  
Lbs. EachList  
Price  
Each

## With 20-inch Flat Radial Reflector

Complete Unit for $\frac{3}{4}$ -inch Bracket .....	344316	13	<b>88 40</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for			
$\frac{3}{4}$ -inch Bracket .....	344349	8	5 70
20-inch flat radial Reflector .....	334746	5	2 70
Complete Unit for 1 $\frac{1}{4}$ -inch Bracket .....	344317	13	<b>8 40</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for			
1 $\frac{1}{4}$ -inch Bracket .....	344350	8	5 70
20-inch flat Radial Reflector .....	334746	5	2 70



## With 18-inch Radial Bowl Reflector

Complete Unit for $\frac{3}{4}$ -inch Bracket .....	344308	12	<b>8 40</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for			
$\frac{3}{4}$ -inch Bracket .....	344349	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
Complete Unit for 1 $\frac{1}{4}$ -inch Bracket .....	344309	12	<b>8 40</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for			
1 $\frac{1}{4}$ -inch Bracket .....	344350	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70

With 18-inch Radial Bowl Reflector and  
6  $\frac{1}{2}$ -inch Holophane Superlux Refractor

Complete Unit for $\frac{3}{4}$ -inch Bracket .....	344310	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for			
$\frac{3}{4}$ -inch Bracket .....	344349	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 $\frac{1}{2}$ -inch Holophane Superlux Refractor .....	335967	5	4 20
Hinged Refractor Holder .....	344352	3	1 80
Complete Unit for 1 $\frac{1}{4}$ -inch Bracket .....	344311	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for			
1 $\frac{1}{4}$ -inch Bracket .....	344350	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 $\frac{1}{2}$ -inch Holophane Superlux Refractor .....	335967	5	4 20
Hinged Refractor Holder .....	344352	3	1 80

With 18-inch Radial Bowl Reflector and  
6  $\frac{1}{2}$ -inch Holophane Skirted Refractor

Complete Unit for $\frac{3}{4}$ -inch Bracket .....	344312	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for			
$\frac{3}{4}$ -inch Bracket .....	344349	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 $\frac{1}{2}$ -inch Holophane Skirted Refractor .....	335980	5	4 20
Hinged Refractor Holder .....	344352	3	1 80
Complete Unit for 1 $\frac{1}{4}$ -inch Bracket .....	344313	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for			
1 $\frac{1}{4}$ -inch Bracket .....	344350	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 $\frac{1}{2}$ -inch Holophane Skirted Refractor .....	335980	5	4 20
Hinged Refractor Holder .....	344352	3	1 80



\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

7-304A

## SERIES SYSTEMS—Continued

## REGENT C SERIES STREETHOODS

## Bracket Type

For 2500, 4000 and 6000-Lumen Type C Series Lamps\*

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension</b>			
<b>Complete Unit for ¾-inch Bracket</b> .....	<b>344326</b>	<b>13</b>	<b>\$9 30</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket .....	<b>344349</b>	<b>8</b>	<b>5 70</b>
20-inch Radial Bowl Reflector with Extension ..	<b>336153</b>	<b>5</b>	<b>3 60</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>344327</b>	<b>13</b>	<b>9 30</b>
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for 1¼-inch Bracket .....	<b>344350</b>	<b>8</b>	<b>5 70</b>
20-inch Radial Bowl Reflector with Extension ..	<b>336153</b>	<b>5</b>	<b>3 60</b>
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Superlux Refractor</b>			
<b>Complete Unit for ¾-inch Bracket</b> .....	<b>344318</b>	<b>24</b>	<b>16 80</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket .....	<b>344349</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
8½-inch Holophane Superlux Refractor .....	<b>352939</b>	<b>9</b>	<b>6 60</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>344319</b>	<b>24</b>	<b>16 80</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1¼-inch Bracket .....	<b>344350</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
8½-inch Holophane Superlux Refractor .....	<b>352939</b>	<b>9</b>	<b>6 60</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Skirted Refractor</b>			
<b>Complete Unit for ¾-inch Bracket</b> .....	<b>344320</b>	<b>23</b>	<b>16 80</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket .....	<b>344349</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
8½-inch Holophane Skirted Refractor .....	<b>252212</b>	<b>8</b>	<b>6 60</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>344321</b>	<b>23</b>	<b>16 80</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1¼-inch Bracket .....	<b>344350</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
8½-inch Holophane Skirted Refractor .....	<b>252212</b>	<b>8</b>	<b>6 60</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>
<b>With 18-inch Radial Bowl Reflector and Sol-lux Diffuser</b>			
<b>Complete Unit for ¾-inch Bracket</b> .....	<b>344324</b>	<b>20</b>	<b>13 20</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket .....	<b>344349</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
Sol-Lux Diffuser .....	<b>338063</b>	<b>5</b>	<b>3 00</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>344325</b>	<b>20</b>	<b>13 20</b>
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1¼-inch Bracket .....	<b>344350</b>	<b>8</b>	<b>5 70</b>
18-inch Radial Bowl Reflector .....	<b>335940</b>	<b>4</b>	<b>2 70</b>
Sol-Lux Diffuser .....	<b>338063</b>	<b>5</b>	<b>3 00</b>
Hinged Refractor Holder .....	<b>344351</b>	<b>3</b>	<b>1 80</b>



\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

## SERIES SYSTEMS—Continued

## CUTTER STANDARD SERIES STREETHOODS

## Bracket Type

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*

Standard Package Quantity 10



Description

Style No.

Ship. Wt.  
Lbs. EachList  
Price  
Each

## With 20-inch Flat Radial Reflector

<b>Complete Unit for ¾-inch Bracket</b> .....	<b>353453</b>	13	<b>\$8 40</b>
Consists of two parts as follows:			
Porcelain head with socket and canopy for ¾-inch bracket .....	<b>353122</b>	8	<b>5 70</b>
20-inch flat radial reflector .....	<b>334746</b>	5	<b>2 70</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>353454</b>	13	<b>8 40</b>
Consists of two parts as follows:			
Porcelain head with socket and canopy for 1¼-inch bracket .....	<b>353123</b>	8	<b>5 70</b>
20-inch flat radial reflector .....	<b>334746</b>	5	<b>2 70</b>



## With 18-inch Radial Bowl Reflector

<b>Complete Unit for ¾-inch Bracket</b> .....	<b>353445</b>	12	<b>8 40</b>
Consists of two parts as follows:			
Porcelain head with socket and canopy for ¾-inch bracket .....	<b>353122</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>
<b>Complete Unit for 1¼-inch bracket</b> .....	<b>353446</b>	12	<b>8 40</b>
Consists of two parts as follows:			
Porcelain head with socket and canopy for 1¼-inch bracket .....	<b>353123</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>



## With 18-inch Radial Bowl Reflector and 6½-inch Holophane Superlux Refractor

<b>Complete Unit for ¾-inch Bracket</b> .....	<b>353447</b>	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain head with socket and canopy for ¾-inch bracket .....	<b>353122</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>
6½-inch Holophane Superlux refractor .....	<b>335987</b>	5	<b>4 20</b>
Hinged refractor holder .....	<b>344352</b>	3	<b>1 80</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>353448</b>	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain head with socket and canopy for 1¼-inch bracket .....	<b>353123</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>
6½-inch Holophane Superlux Refractor .....	<b>335987</b>	5	<b>4 20</b>
Hinged refractor holder .....	<b>344352</b>	3	<b>1 80</b>



## With 18-inch Radial Bowl Reflector and 6½-inch Holophane Skirted Refractor

<b>Complete Unit for ¾-inch Bracket</b> .....	<b>353449</b>	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain head with socket and canopy for ¾-inch bracket .....	<b>353122</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>
6½-inch Holophane skirted refractor .....	<b>335980</b>	5	<b>4 20</b>
Hinged refractor holder .....	<b>344352</b>	3	<b>1 80</b>
<b>Complete Unit for 1¼-inch Bracket</b> .....	<b>353450</b>	20	<b>14 40</b>
Consists of four parts as follows:			
Porcelain head with socket and canopy for 1¼-inch bracket .....	<b>353123</b>	8	<b>5 70</b>
18-inch radial bowl reflector .....	<b>335940</b>	4	<b>2 70</b>
6½-inch Holophane skirted refractor .....	<b>335980</b>	5	<b>4 20</b>
Hinged refractor holder .....	<b>344352</b>	3	<b>1 80</b>

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

7-317A

## SERIES SYSTEMS—Continued

## CUTTER STANDARD SERIES STREETHOODS

## Bracket Type

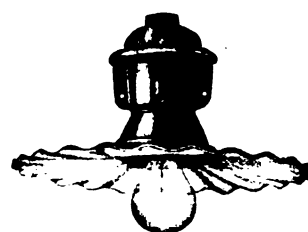
For 2500, 4000, and 6000 Lumen Type C Series Lamps\*

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Unit for ¾-inch Bracket.....	353463	13	\$9 30
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket.....	353123	8	5 70
20-inch Radial Bowl Reflector with extension..	336153	5	3 60
Complete Unit for 1 ¼-inch Bracket.....	353464	13	9 30
Consists of two parts as follows:			
Porcelain Head with Socket and Canopy for 1 ¼-inch Bracket.....	353123	8	5 70
20-inch Radial Bowl Reflector with Extension..	336153	5	3 60
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Superlux Refractor</b>			
Complete Unit for ¾-inch Bracket.....	353455	24	16 80
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8½-inch Holophane Superlux Refractor.....	352939	9	6 60
Hinged Refractor Holder.....	344351	3	1 80
Complete Unit for 1 ¼-inch Bracket.....	353456	24	16 80
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1 ¼-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8½-inch Holophane Superlux Refractor.....	352939	9	6 60
Hinged Refractor Holder.....	344351	3	1 80
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Skirted Refractor</b>			
Complete Unit for ¾-inch Bracket.....	353457	23	16 80
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8½-inch Holophane Skirted Refractor.....	252212	8	6 60
Hinged Refractor Holder.....	344351	3	1 80
Complete Unit for 1 ¼-inch Bracket.....	353458	23	16 80
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1 ¼-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8½-inch Holophane Skirted Refractor.....	252212	8	6 60
Hinged Refractor Holder.....	344351	3	1 80
<b>With 18-inch Radial Bowl Reflector and Sol-Lux Diffuser</b>			
Complete Unit for ¾-inch Bracket.....	353461	20	13 20
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for ¾-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
Sol-Lux Diffuser.....	336063	5	3 00
Hinged Refractor Holder.....	344351	3	1 80
Complete Unit for 1 ¼-inch Bracket.....	353462	20	13 20
Consists of four parts as follows:			
Porcelain Head with Socket and Canopy for 1 ¼-inch Bracket.....	353123	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
Sol-Lux Diffuser.....	336063	5	3 00
Hinged Refractor Holder.....	344351	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number



SERIES SYSTEMS—Continued

CUTTER STREETHOOD BRACKETS

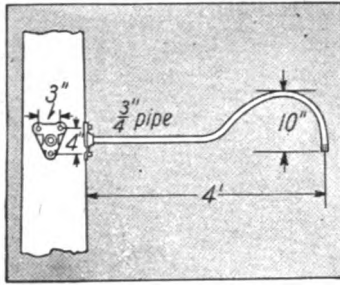
3/4-Inch Fitting

Standard Package Quantity 10

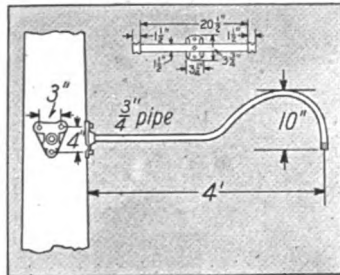
Prices below cover brackets only. Streethood Bodies to make complete Bracket Type Streethoods should be selected from the four preceding pages and ordered separately.

Type B Bracket

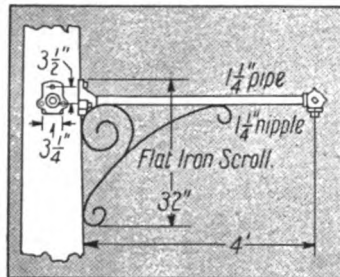
The type B Bracket consists of 4-foot type B gooseneck of 3/4-inch pipe with a 3-hole grooved pole plate, which permits either inner or outer wiring. The holes in the pole plate are 3/8 inch in diameter to take 1/2-inch lag screws.



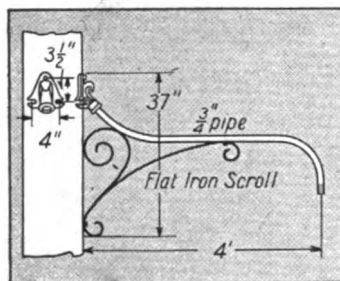
TYPE B BRACKET



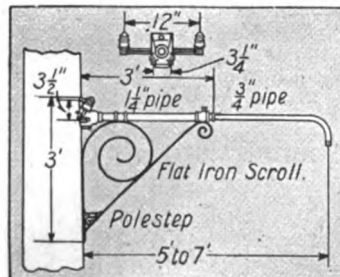
TYPE B BRACKET WITH BRACE ARM



SPARTAN STRAIGHT ARM BRACKET



MAJESTIC MEDIUM BRACKET



BOULEVARD TELESCOPE BRACKET

Description	Style No.	Ship. Wt. Lbs., Each	List Price
Complete Bracket	340758	10	\$1 75
Consists of two parts as follows:			
3/4-inch x 4-foot Gooseneck	334742	7	1 15
Grooved pole plate	334741	3	60

Type B Bracket With Brace Arm

The Brace Arm is an enameled wood arm with metal bound ends and insulators. It is usually attached to the pole above the bracket and guides the wires to the fixture.

Complete Bracket	344359	13	2 80
Consists of three parts as follows:			
3/4-inch x 4-foot Gooseneck	334742	7	1 15
Grooved pole plate	334741	3	60
Brace arm	334740	3	1 06

Spartan Straight Arm Bracket

The Spartan straight arm bracket is made up of a straight length of 1 1/4-inch pipe with an ornamental headpiece at the outer end, which is equipped with a 3/4-inch nipple for attaching streethood. The 3-hole pole plate which permits inner wiring, is mounted with 1/2-inch lag screws.

Complete Bracket	336516	24	6 00
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Majestic Medium Bracket

The Majestic Medium bracket is a medium weight bracket of 3/4-inch pipe, with 4-feet overhang. It is equipped with a wrought iron scroll and grooved pole plate, which permits inner wiring. Three 1/2-inch lag screws are used in mounting.

Complete Bracket	335958	15	4 20
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Boulevard Telescope Bracket

The 3/4-inch pipe telescopes into the 1 1/4-inch pipe and allows for adjustments of 5 to 7 feet in reach from pole. This bracket has a heavy 3-hole cast iron pole plate for inner wiring and a cross arm with glass insulators. The knurled set screw in the pipe joint and the pole step in the lower corner of the scroll are for the convenience of linemen when renewing lamps.

Complete Bracket	344360	39	10 10
Consists of four parts as follows:			
Pole plate with cross arm	334775	9	2 00
Boulevard bracket with pole step and scroll assembled	334778	20	5 80
3/4-inch x 5-foot pipe bend	334779	8	2 15
2 pony glass insulator	344825	2	15

Galvanizing: When ordered in standard package quantities or over, any of the brackets listed above will be furnished electro-galvanized and painted black, for 20% list additional. In less than standard package quantities add 40%.



SERIES SYSTEMS—Continued

CUTTER STREETHOOD BRACKETS

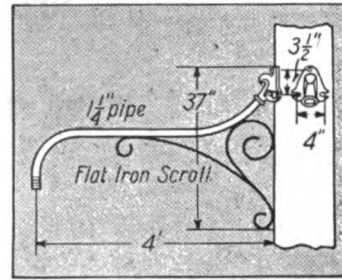
1 1/4-Inch Fitting

Standard Package Quantity 10

Prices below cover brackets only. Streethood Bodies to make complete Bracket Type Streethoods should be selected from the preceding pages and ordered separately.

Majestic Senior Bracket

The Majestic Senior bracket consists of a double bend gooseneck of 1 1/4-inch pipe 4 feet long together with a 3-hole grooved pole plate for inner wiring and a wrought iron scroll. Lag screws 1/2-inch diameter are used for mounting on poles.

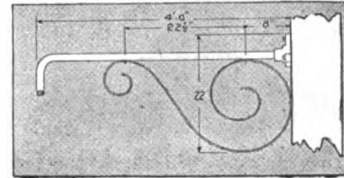


MAJESTIC SENIOR BRACKET

Description	Style No.	Ship. Wt. Lbs. Each	List Price
Complete Bracket	335972	26	\$6 00

Imperial Bracket

The Imperial bracket consists of a 4-foot arm of 1 1/4-inch pipe with a right angle bend at the outer end. It is fitted with a 3-hole grooved pole plate and a simple one piece scroll of wrought iron. The holes in the pole plate are 3/8-inch diameter for 1/2-inch lag screw.

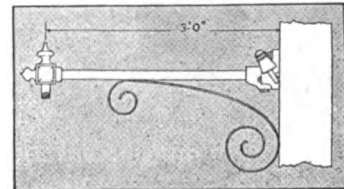


IMPERIAL BRACKET

Complete Bracket	352903	24	6 00
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Arcadian Bracket

A substantial 3-foot bracket made of 1 1/4-inch pipe with 3-hole pole plate, fitted with cross arm and glass insulators. An ornamental headpiece with 1 1/4-inch nipple is used on the outer end and a simple wrought iron scroll acts as a brace.

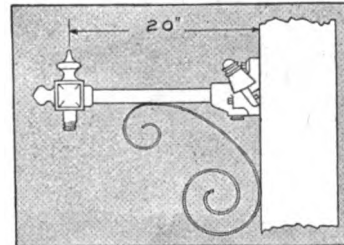


ARCADIAN BRACKET

Complete Bracket	348742	20	7 40
Consists of three parts as follows:			
Arcadian bracket assembled	344532	9	5 25
Pole plate with cross arm	334775	9	2 00
2 pony glass insulators	344825	2	15

Arcadian Junior Bracket

The Arcadian Junior bracket is similar to the Arcadian bracket listed above. It holds the fixture twenty inches from the pole. Lag screws 1/2-inch in diameter are used for mounting on poles.



ARCADIAN JR. BRACKET

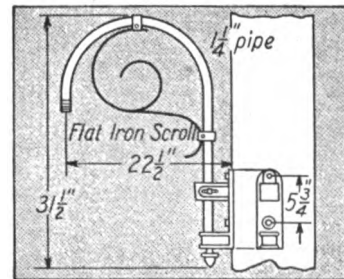
Complete Bracket	344353	14	4 10
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Pole Crook

Made of 1 1/2-inch pipe with wrought iron scroll. Clamps for attaching to pole are adjustable to compensate for the rake on trolley poles.

Complete Bracket for Wooden Poles	344354	28	7 20
Consists of two parts as follows:			
Crook with scroll	334770	20	5 40
Pole plate	344787	8	1 80
Complete Bracket for 4-inch Steel Pole	344355	36	9 60
Consists of two parts as follows:			
Crook with scroll	334770	20	5 40
2 clamps for 4-inch pole	344356	8	4 30
Complete Bracket for 5-inch Steel Pole	344357	38	9 80
Consists of two parts as follows:			
Crook with scroll	334770	20	5 40
2 clamps for 5-inch pole	339227	9	4 40

**Galvanizing:** When ordered in standard package quantities or over, any of the brackets listed above will be furnished electro-galvanized and painted black, for 20% list additional. In less than standard package quantities add 40%.



POLE CROOK

7-307B

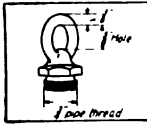
SERIES SYSTEMS—Continued

REGENT C SERIES STREETHOODS

Loop Suspension Type

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*

Loop Suspension Streethoods consist of Streethoods with plain suspension eye, threaded for attachment to 3/4-inch canopy. Designed for use with mast arms, pulleys, insulated cross arms, etc. When so used, the Streethood may be lowered to the ground for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material.)



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Flat Radial Reflector</b>			
Complete Streethood .....	344332	13 1/2	\$8 65
Consists of three parts as follows:			
Loop .....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy .....	344349	8	5 70
20-inch Flat Radial Reflector .....	334746	5	2 70



With 18-inch Radial Bowl Reflector

Complete Streethood .....	344328	12 1/2	8 65
Consists of three parts as follows:			
Loop .....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy .....	344349	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70



With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor

Complete Streethood .....	344329	20 1/2	14 65
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain Head with socket and 3/4-inch Canopy .....	344349	8	5 70
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Superlux Refractor .....	335967	5	4 20
Hinged Refractor Holder .....	344352	3	1 80



With 18-inch Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor

Complete Streethood .....	344330	20 1/2	14 65
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain Head with socket and 3/4-inch Canopy .....	344349	8	5 70
18-inch Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Skirted Refractor .....	335980	5	4 20
Hinged Refractor Holder .....	344352	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

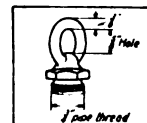
SERIES SYSTEMS—Continued

REGENT C SERIES STREETHOODS

Loop Suspension Type

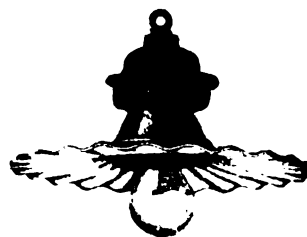
For 2500, 4000 and 6000 Lumen Type C Series Lamps\*

Loop Suspension Streethoods consist of Streethoods with plain suspension eye, threaded for attachment to 3/4-inch canopy. Designed for use with mast arms, pulleys, insulated cross arms, etc. When so used, the Streethood may be lowered to the ground for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material.



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood.....	344337	13 1/2	\$9 55
Consists of three parts as follows:			
Loop.....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
20-inch Radial Bowl Reflector with Extension..	336153	5	3 60



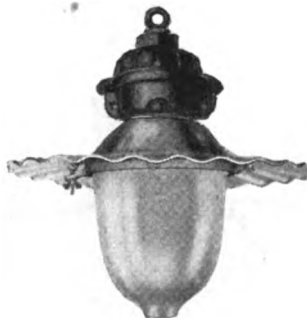
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood.....	344333	24 1/2	17 05
Consists of five parts as follows:			
Loop.....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8 1/2-inch Holophane Superlux Refractor.....	352939	9	6 60
Hinged Refractor Holder.....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood.....	344334	23 1/2	17 05
Consists of five parts as follows:			
Loop.....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8 1/2-inch Holophane Skirted Refractor.....	352212	8	6 60
Hinged Refractor Holder.....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and Sol-Lux Diffuser</b>			
Complete Streethood.....	344336	20 1/2	13 45
Consists of five parts as follows:			
Loop.....	338841	1/2	25
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
Sol-Lux Diffuser.....	336063	5	3 00
Hinged Refractor Holder.....	344351	3	1 80



\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

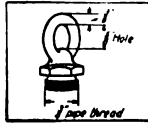
Order by Style Number

SERIES SYSTEMS—Continued

CUTTER STANDARD SERIES STREETHOODS

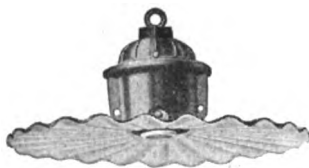
Loop Suspension Type

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*



Loop Suspension Streethoods consist of streethoods with plain suspension eye, threaded for attachment to 1/4-inch canopy. Designed for use with mast arms, pulleys, insulated cross arms, etc. When so used, the streethood may be lowered to the ground for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material.)

Standard Package Quantity 10



Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Flat Radial Reflector</b>			
Complete Streethood .....	351469	13 1/2	\$8 65
Consists of three parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 1/4-inch canopy .....	353122	8	5 70
20-inch flat radial reflector .....	334746	5	2 70



<b>With 18-inch Radial Bowl Reflector</b>			
Complete Streethood .....	351466	12 1/2	8 65
Consists of three parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 1/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood .....	351467	20 1/2	14 65
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 1/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
6 1/2-inch Holophane Superlux refractor .....	335967	5	4 20
Hinged refractor holder .....	344352	3	1 80



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood .....	351468	20 1/2	14 65
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 1/4-inch canopy .....	353122	8	5 70
18-inch bowl reflector .....	335940	4	2 70
6 1/2-inch Holophane skirted refractor .....	335980	5	4 20
Hinged refractor holder .....	344352	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one tenth of the lumen rating.

Order by Style Number

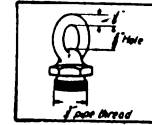
SERIES SYSTEMS—Continued

CUTTER STANDARD SERIES STREETHOODS

Loop Suspension Type

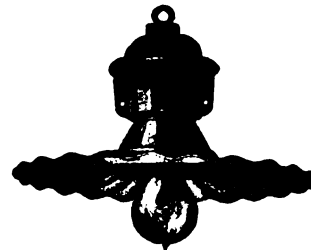
For 2500, 4000 and 6000 Lumen Type C Series Lamps\*

Loop Suspension Streethoods consist of streethoods with plain suspension eye, threaded for attachment to 3/4-inch canopy. Designed for use with mast arms, pulleys, insulated cross arms, etc. When so used, the streethood may be lowered to the ground for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material).



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood .....	351473	13 1/2	\$9 55
Consists of three parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
20-inch radial bowl reflector with extension .....	336153	5	3 60



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood .....	351470	24 1/2	17 05
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Holophane Superlux refractor .....	352939	9	6 60
Hinged refractor holder .....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood .....	351471	23 1/2	17 05
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Holophane skirted refractor .....	252212	8	6 60
Hinged refractor holder .....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and Sol-Lux Diffuser</b>			
Complete Streethood .....	351472	20 1/2	13 45
Consists of five parts as follows:			
Loop .....	338841	1/2	25
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
Sol-Lux diffuser .....	336083	5	3 00
Hinged refractor holder .....	344351	3	1 80



\*Lamps are not included. The nominal candle power of series lamps is one tenth of the lumen rating.

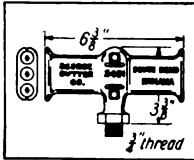
Order by Style Number

SERIES SYSTEMS—Continued

REGENT C SERIES STREETHOODS

Cable Grip Suspension

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*



Cable Grip Suspension Streethoods consists of Streethoods with rigid cable clamp threaded for attachment to 3/4-inch canopy. Line wires may be tied in the rim of the porcelain head, making a cross arm unnecessary. The clamp compensates for unequal sag in the cable so that the fixture may be adjusted to a level position.

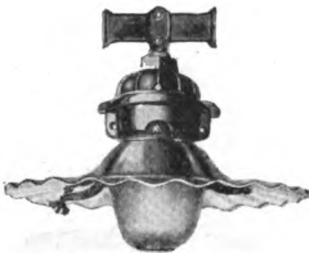
Standard Package Quantity 10



Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Flat Radial Reflector</b>			
<b>Complete Streethood</b> .....	<b>334342</b>	16	<b>\$9 15</b>
Consists of three parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
20-inch Flat Radial Reflector.....	334746	5	2 70



<b>With 18-inch Radial Bowl Reflector</b>			
<b>Complete Streethood</b> .....	<b>344338</b>	15	<b>9 15</b>
Consists of three parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor</b>			
<b>Complete Streethood</b> .....	<b>344339</b>	23	<b>15 15</b>
Consists of five parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
6 1/2-inch Holophane Superlux Refractor.....	335967	5	4 20
Hinged Refractor Holder.....	344352	3	1 80



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor</b>			
<b>Complete Streethood</b> .....	<b>344340</b>	23	<b>15 15</b>
Consists of five parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
6 1/2-inch Holophane Skirted Refractor.....	335980	5	4 20
Hinged Refractor Holder.....	344352	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

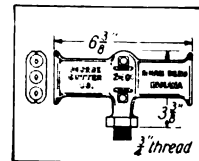
SERIES SYSTEMS—Continued

REGENT C SERIES STREETHOODS

Cable Grip Suspension

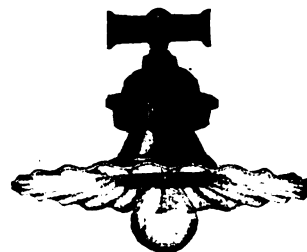
For 2500, 4000 and 6000 Lumen Type C Series Lamps\*

Cable Grip Suspension Streethoods consist of Streethoods with rigid cable clamp threaded for attachment to 3/4-inch canopy. Line wires may be tied in the rim of the porcelain head, making a cross arm unnecessary. The clamp compensates for unequal sag in the cable so that the fixture may be adjusted to a level position.



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood.....	344348	16	10 05
Consists of three parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy.....	344349	8	5 70
20-inch Radial Bowl Reflector with Extension..	336153	5	3 60



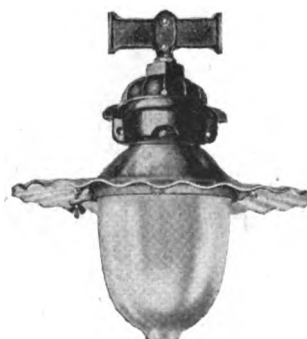
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood.....	344344	27	\$17 55
Consists of five parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy.....	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8 1/2-inch Holophane Superlux Refractor.....	352939	9	6 80
Hinged Refractor Holder.....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood.....	344345	26	17 55
Consists of five parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy.....	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8 1/2-inch Holophane Skirted Refractor.....	252212	8	6 80
Hinged Refractor Holder.....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Sol-Lux Diffuser</b>			
Complete Streethood.....	344347	23	13 95
Consists of five parts as follows:			
Cable Clamp.....	336517	3	75
Porcelain Head with Socket and 3/4-inch Canopy.....	344349	8	5 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
8 1/2-inch Sol-Lux Diffuser.....	336063	5	3 00
Hinged Refractor Holder.....	344351	3	1 80



\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

7-311A

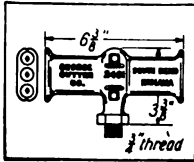
SERIES SYSTEMS—Continued

CUTTER STANDARD SERIES STREETHOODS

Cable Grip Suspension

For 400, 600, 800 and 1000 Lumen Type C Series Lamps\*

Cable Grip Suspension Streethoods consist of Cutter Streethoods with rigid cable clamp threaded for attachment to 3/4-inch canopy. Line wires may be tied in the rim of the porcelain head, thereby obviating the necessity of a cross arm. The cable clamp compensates for unequal sag in the cable so that the fixture may be adjusted to a level position.



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
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With 20-inch Flat Radial Reflector



Complete Streethood .....	351477	16	\$9 15
Consists of three parts as follows:			
Cable clamp .....	336517	3	75
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
20-inch flat radial reflector .....	334746	5	2 70

With 18-inch Radial Bowl Reflector



Complete Streethood .....	351474	15	9 15
Consists of three parts as follows:			
Cable clamp .....	336517	3	75
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor



Complete Streethood .....	351475	23	15 15
Consists of five parts as follows:			
Cable clamp .....	336517	3	75
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
6 1/2-inch Holophane Superlux refractor .....	335987	5	4 20
Hinged refractor holder .....	344352	3	1 80

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor



Complete Streethood .....	351476	23	15 15
Consists of five parts as follows:			
Cable clamp .....	336517	3	75
Porcelain head with socket and 3/4-inch canopy .....	353122	8	5 70
18-inch radial bowl reflector .....	335940	4	2 70
6 1/2-inch Holophane skirted refractor .....	335980	5	4 20
Hinged refractor holder .....	344352	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one tenth of the lumen rating.

Order by Style Number



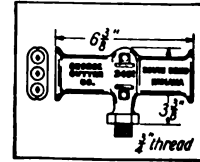
SERIES SYSTEMS—Continued

CUTTER STANDARD SERIES STREETHOODS

Cable Grip Suspension

For 2500, 4000, and 6000 Lumen Type C Series Lamps\*

Cable Grip Suspension Streethoods consist of Cutter Streethoods with rigid cable clamp threaded for attachment to 3/4-inch canopy. Line wires may be tied in the rim of the porcelain head, thereby obviating the necessity of a cross arm. The cable clamp compensates for unequal sag in the cable so that the fixture may be adjusted to a level position.



Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood	351481	16	\$10 05
Consists of three parts as follows:			
Cable clamp	336517	3	75
Porcelain head with socket and 3/4-inch canopy	353122	8	5 70
20-inch radial bowl reflector with extension	336153	5	3 60

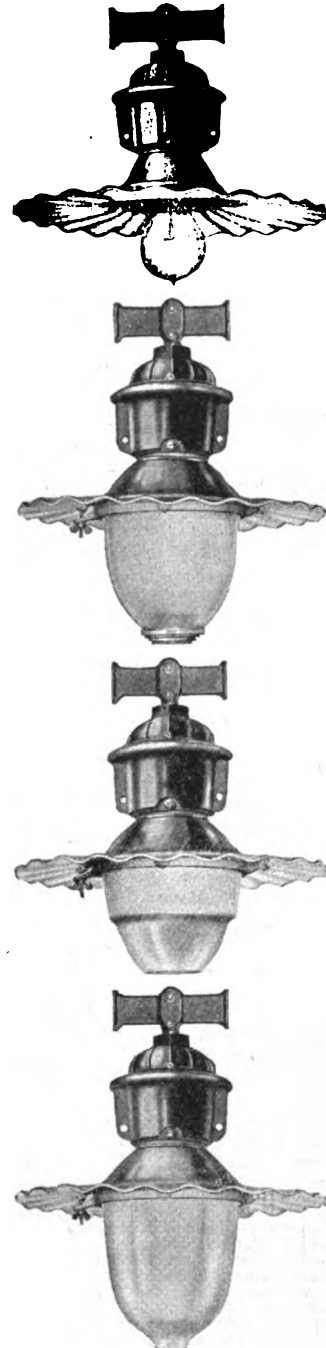
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood	351478	27	17 55
Consists of five parts as follows:			
Cable clamp	336517	3	75
Porcelain head with socket and 3/4-inch canopy	353122	8	5 70
18-inch radial bowl reflector	335940	4	2 70
8 1/2-inch Holophane Superlux refractor	352939	9	6 60
Hinged refractor holder	344351	3	1 80

<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood	351479	26	17 55
Consists of five parts as follows:			
Cable clamp	336517	3	75
Porcelain head with socket and 3/4-inch canopy	353122	8	5 70
18-inch radial bowl reflector	335940	4	2 70
Holophane skirted refractor	352212	8	6 60
Hinged refractor holder	344351	3	1 80

<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Sol-Lux Diffuser</b>			
Complete Streethood	351480	23	13 95
Consists of five parts as follows:			
Cable clamp	336517	3	75
Porcelain head with socket and 3/4-inch canopy	353122	8	5 70
18-inch radial bowl reflector	335940	4	2 70
8 1/2-inch Sol-Lux diffuser	336083	5	3 00
Hinged refractor holder	344351	3	1 80

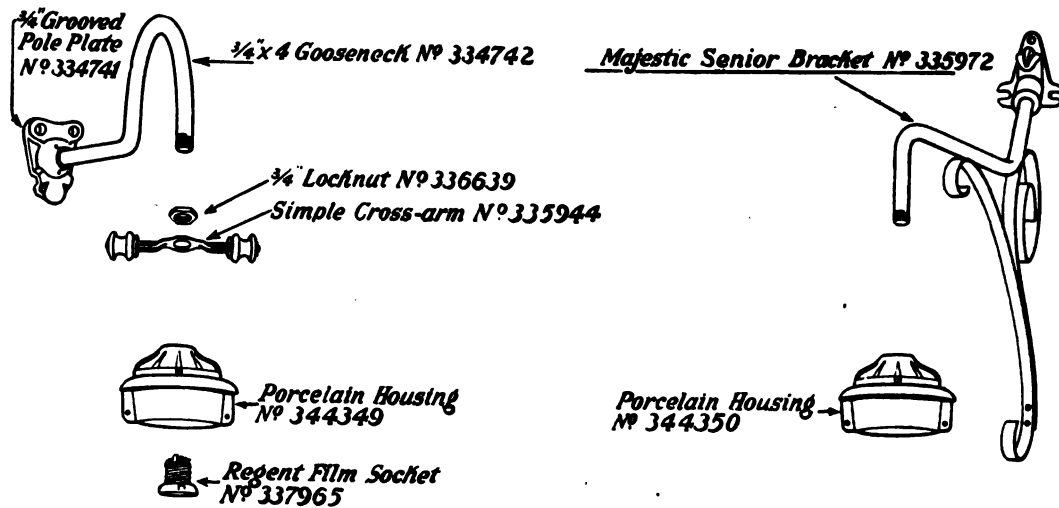
\*Lamps are not included. The nominal candle power of series lamps is one tenth of the lumen rating.

Order by Style Number

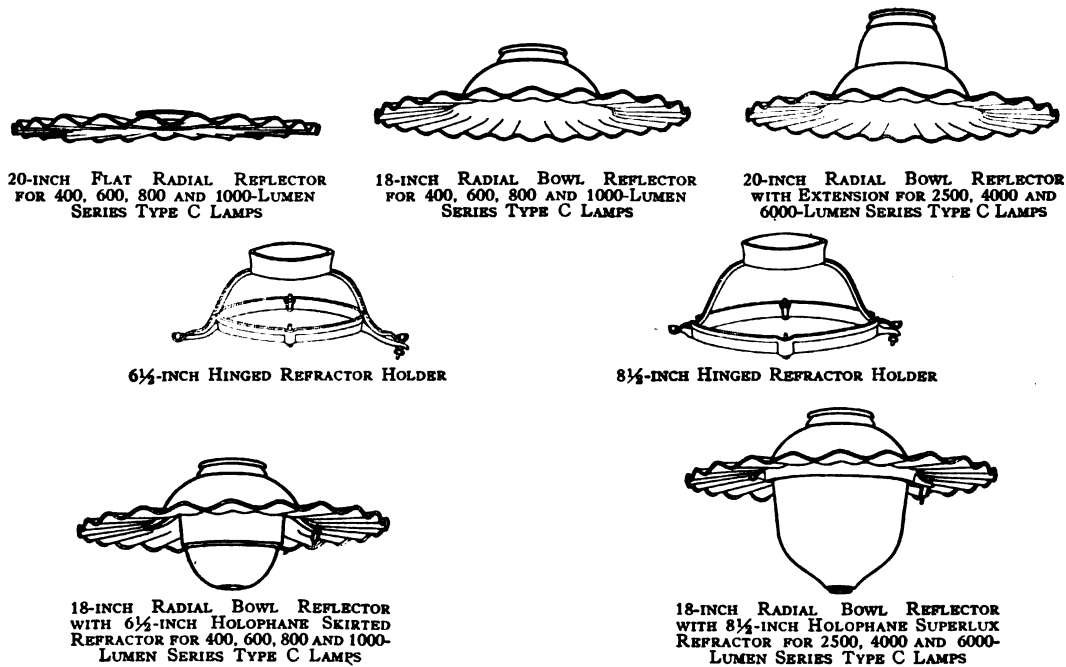


SERIES SYSTEMS—Continued

PARTS FOR BRACKET SUSPENSION SERIES STREETHOODS



PARTS FOR BRACKET SUSPENSION STREETHOODS



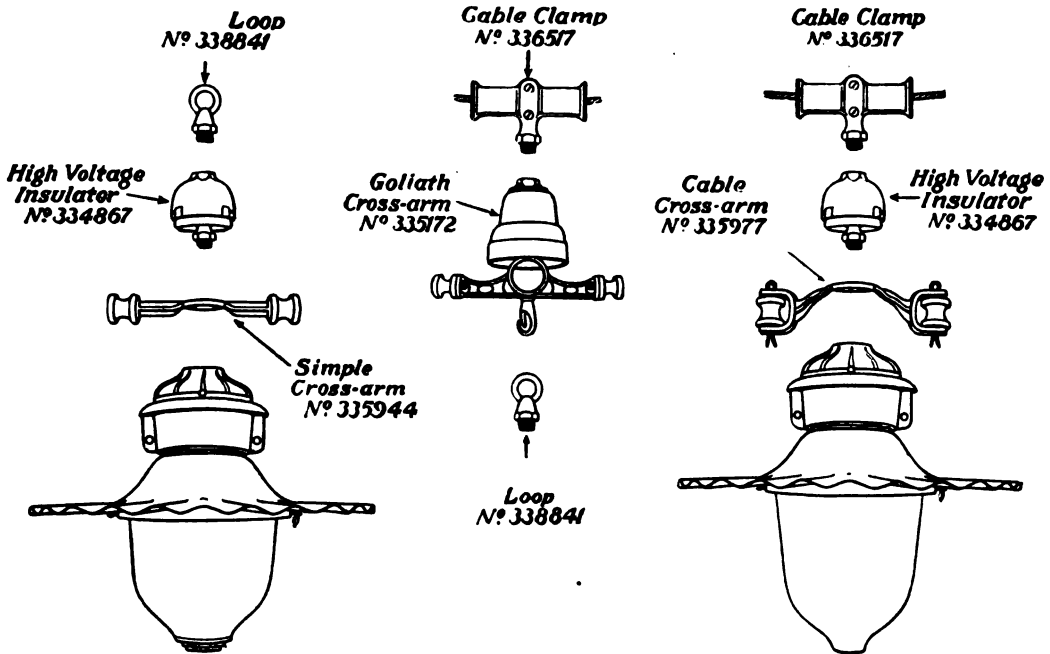
Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
Porcelain Head with Regent C Socket and 3/4-inch Canopy.....	344349	8	\$5 70
Porcelain Head with Regent C Socket and 1 1/4-inch Canopy.....	344350	8	5 70
Porcelain Head with Standard Film Socket and 3/4-inch Canopy.....	353122	8	5 70
Porcelain Head with Standard Film Socket and 1 1/4-inch Canopy.....	353123	8	5 70
Regent "C" Lamp Holder.....	337965	1/4	1 10
Standard Film Socket.....	352937	1	1 20
20-inch Flat Radial Reflector.....	334746	5	2 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
20-inch Radial Bowl Reflector with Extension.....	338153	5	3 60
6 1/2-inch Holophane Superlux Refractor.....	335967	5	4 20
6 1/2-inch Holophane Skirted Refractor.....	335980	5	4 20
8 1/4-inch Holophane Superlux (open type) Refractor.....	352939	9	6 60
8 1/4-inch Holophane Skirted Refractor.....	252112	8	6 60
8 1/4-inch "Sol-lux" Diffuser.....	338083	5	3 00
6 1/2-inch Hinged Refractor Holder.....	344352	3	1 80
8 1/4-inch Hinged Refractor Holder.....	344351	3	1 80
Simple Cross Arm for 3/4-inch pipe.....	335944	1 1/2	60
Locknut for 3/4-inch pipe.....	336639	...	05
Simple Cross Arm for 1 1/4-inch Pipe.....	335922	1 1/2	60
Locknut for 1 1/4-inch Pipe.....	336787	...	05

Order by Style Number

SERIES SYSTEMS—Continued

SUSPENSION FITTINGS FOR SERIES STREETHOODS



INTERCHANGEABLE PARTS FOR CENTER SUSPENSION STREETHOODS

The Streethoods listed on the preceding pages may be equipped with various types of suspension fittings. The interchangeability of parts permits a large number of combinations. For convenience, the combinations most generally used are illustrated above and listed below.

Standard Package Quantity, 10

Description	Style No.	Shp. Wt. Lbs. Each	List Price Each
Loop.....	338841	½	\$0 25
Complete Fittings.....	344363	3½	85
Consists of two parts as follows:			
Loop.....	338841	½	25
Simple Cross Arm.....	335944	3	60
Complete Fittings.....	344364	3½	1 65
Consists of two parts as follows:			
Loop.....	338841	½	25
High Voltage Insulator.....	334867	3	1 40
Complete Fittings.....	344365	5	2 25
Consists of three parts as follows:			
Loop.....	338841	½	25
High Voltage Insulator.....	334867	3	1 40
Simple Cross Arm.....	335944	1½	60
Cable Clamp.....	336517	3	75
Complete Fittings.....	344366	6	1 55
Consists of two parts as follows:			
Cable Clamp.....	336517	3	75
Cable Cross Arm.....	335977	3	80
Complete Fittings.....	344367	6	2 15
Consists of two parts as follows:			
Cable Clamp.....	336517	3	75
High Voltage Insulator.....	334867	3	1 40
Complete Fittings.....	344368	9	2 95
Consists of three parts as follows:			
Cable Clamp.....	336517	3	75
High Voltage Insulator.....	334867	3	1 40
Cable Cross Arm.....	335977	3	80
Complete Fittings.....	344369	13½	4 95
Consists of three parts as follows:			
Cable Clamp.....	336517	3	75
Goliath Cross Arm.....	335172	10	3 95
Loop.....	338841	½	25

Order by Style Number

## SERIES SYSTEMS—Continued

## THE CUTTER REGENT FILM SOCKET

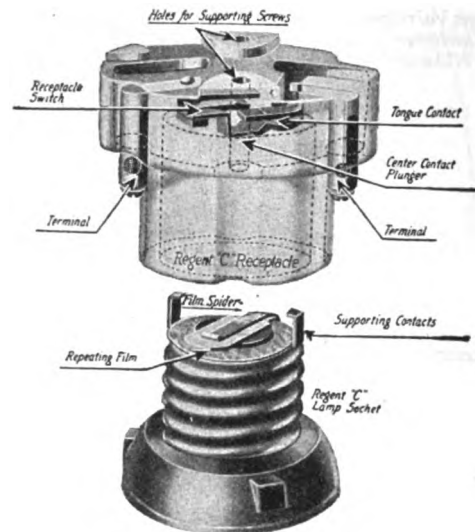
In a straight series lighting system, the constant-current transformer which regulates the voltage to compensate for burned out lamps may be considered the heart of the system, while the **Regent Film Socket is the safety valve.**

When a lamp burns out, there is a momentary rise in potential across the terminals of the lamp and the dielectric film in the socket must puncture to re-establish the circuit. If the dielectric strength of the film is too great, the rise of the voltage may not be sufficient to puncture the film, or it may hold the circuit open until the voltage has increased to a point that will produce violent surges in the line. These surges are damaging to type C lamps, because the filament must be kept so near the melting point that a line surge of any consequence destroys the lamp.

The film used in the Regent Socket punctures uniformly and accurately at rated voltage. It is enclosed in the socket and protected against climatic conditions which might prevent this accuracy. The film cannot creep out as a result of vibration of the fixture and lamp.

Regent Film Sockets have been thoroughly tried out by the users of the country. Hundreds of thousands are in service under all climatic conditions. Approximately 30,000 have been installed in the city of Chicago alone, where they are used in Cutter pendants and in ornamental posts for type C lamps.

To the many well known advantages of the Regent Socket, improvements have been added to make the Regent C Socket, illustrated below, the ideal "safety valve" socket.



PHANTOM VIEW OF REGENT C RECEPTACLE WITH VIEW OF LAMP SOCKET. SHOWING REPEATING FILM

## Regent C Film Sockets Solve Outage Problems

Outage penalties eat into the profits and accidents occur because of darkness. No such condition can arise with the **repeating film**. Lift the spring spider, turn the film a fraction of an inch, close it

and screw in a new lamp. Insert the socket in the receptacle and the lamp is ready for operation. The saving in cost of film renewals alone will pay for the socket in a short time.

## Advantages of Regent C Film Sockets

Use Regent C Sockets with Cutter pendants, streethoods, posts and other fixtures with straight series lamps. The following advantages are obtained:

1. The repeating film saves trouble and time, and decreases the expense of renewals.
2. Only the calibrated film can be used with Regent C Sockets.
3. Large contact surface and uniform pressure insure accuracy in film puncture.
4. Fool-proof construction insures the proper use of the film and socket.
5. The film is enclosed in the socket, protecting it against climatic conditions which might prevent accuracy in film puncture.
6. There are no live metal parts exposed back of the socket; this construction eliminates danger from corrosion and short circuits.
7. The intense heat of type C lamps cannot affect the operation of the film.
8. The lamp socket is easily inserted in the receptacle; a slight turn locks it in place.
9. Lamps may be renewed easily by hand or with lamp-changer from the ground.
10. Lamps may be inserted in the lamp socket shells at the storeroom and carried in this manner by the linemen to the places where renewals are made.
11. The Regent C Socket is smaller and better insulated than other designs.

SERIES SYSTEMS—Continued

THE UNIVERSAL PORCELAIN HEAD



WITH REGENT C FILM SOCKET STYLE NO. 337960



UNIVERSAL PORCELAIN HEAD



WITH STANDARD FILM SOCKET STYLE NO. 341135

The Universal porcelain head consists of a porcelain body or case and canopy. The body is designed on the same general lines as the porcelain heads used in both Regent C and Standard street-hoods, but the socket is not built in as an integral part.

The general shape, as well as the dielectric and mechanical strength are the same. Outside wires enter at an upward angle, so that water cannot follow the wire into the fixture. When outer wiring is used, the wires may be tied to lugs provided on the outside of the head, making the use of a cross arm unnecessary. These lugs are so arranged that the lead-in wires are held at the greatest possible distance from the canopy.

Each porcelain head is equipped with an iron supporting ring, which grips and locks the reflector. It is so arranged that the reflectors can be installed or removed by the adjustment of only one screw.

This screw is so arranged, however, that the weight of the reflector and glassware is not thrown upon it.

All iron parts are heavily galvanized and painted with one coat of black enamel. The canopy is secured in place by three large screws seated in lead slugs embedded in the porcelain. The top of the canopy is cast hexagonal in shape, to facilitate installing. Canopies are tapped for both 3/4-inch pipe and 1 1/4-inch pipe.

The interior of the head is so arranged that either medium or mogul multiple sockets, as well as Regent C and Standard film sockets may be used interchangeably.

At the top, a standard line of suspension fittings in various combinations may be used. Below, any of the standard combinations of reflectors, with or without glassware may be used to make up a complete Streethood.



WITH MEDIUM SCREW SOCKET STYLE NO. 334749



WITH MOGUL SCREW SOCKET STYLE NO. 334751

Universal Porcelain Heads without Sockets

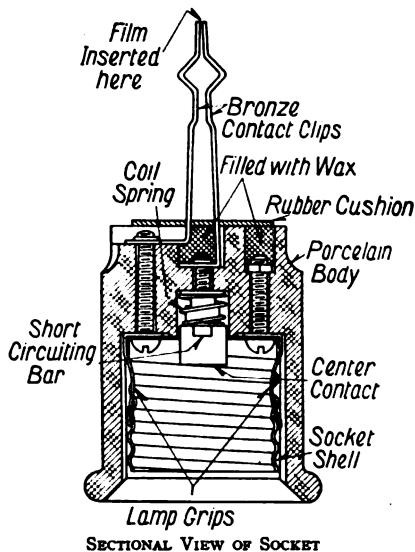
Consist of porcelain body to take either Regent C film socket Style No. 337960 or standard film socket Style No. 341135, medium socket Style No. 334749 or mogul socket Style No. 334751, cast-iron canopy tapped for 3/4-inch or 1 1/4-inch pipe, and adapter ring to fit reflectors with 4-inch standard heel. Sockets are not included and must be ordered separately. See listing on page 831.

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
With 3/4-inch canopy, without socket.....	338051	8	\$3 75
With 1 1/4-inch canopy, without socket.....	338052	8	3 75

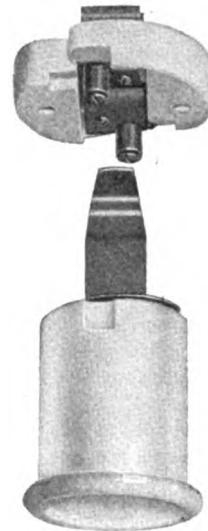
Order by Style Number

## SERIES SYSTEMS—Continued

## STANDARD FILM SOCKETS



SECTIONAL VIEW OF SOCKET



STANDARD FILM SOCKET AND RECEPTACLE

The standard film socket is used on series systems operated by constant current regulating transformers. The theory of operation is the same as for the Regent C Film Socket. When a lamp burns out, there is a momentary rise in potential across the socket terminals and the dielectric film must puncture to re-establish the circuit.

The receptacle consists of a flat porcelain disc arranged with a pair of spring clips. These clips are so arranged that they make contact under tension at all times. The receptacle is provided with binding posts, to which the line wires may be connected. The clips are reinforced to insure their reliability in operation.

The socket consists of a porcelain husk, to which is attached the contact prongs on the back and the lamp contacts on the inside. The prongs on the

back are made of spring bronze, so that the disc film will be held firmly in place. When inserted in the receptacle, these prongs automatically connect the socket to the line.

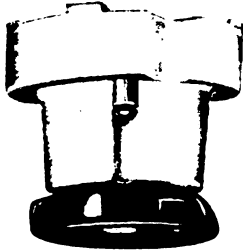
A short circuiting switch maintains the circuit in case the socket is inserted in the receptacle without a lamp. This switch is so arranged that it forms the center contact for the lamp which, when screwed in place, opens the switch and is thereby connected to the circuit. This short circuiting switch is positive in action, so that the possibility of failure is very remote. The socket shell is equipped with grips so that the lamp cannot become loose and drop out in service.

A rubber bumper is used on the top of the socket to take up the shock when it is forced in place.

SERIES SYSTEMS—Continued

CUTTER STREETHOOD SOCKETS

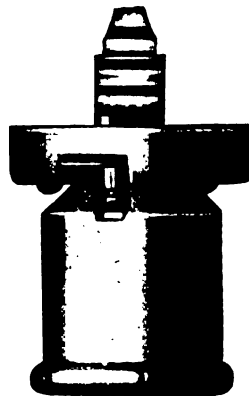
Regent C Film Sockets



REGENT C FILM SOCKET

The Regent C Film Sockets and Receptacles are described in detail on page 828. These sockets are for use with porcelain heads Style No. 338051 and Style No. 338052 listed on page 829 or with other styles of streethoods which are arranged for standard hood forks.

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
Receptacle, mogul base socket and film holder.....	337960	1 1/4	\$1 95
Receptacle, mogul base socket and film holder with 1/4-inch hood fork, rigid male nipple.....	337961	1 1/4	2 35
Receptacle, mogul base socket and film holder with 1/4-inch hood fork, female thread.....	337962	1 1/4	2 50
Receptacle, mogul base socket and film holder with 1/2-inch hood fork, female thread.....	337963	1 1/2	2 50
Lamp socket only with film holder.....	337965	1/4	1 00
Package of 50 silk films, puncture voltage 300.....	334943	...	1 50



STANDARD FILM RECEPTACLE AND MOGUL BASE SOCKET

Standard Film Sockets

Have a porcelain receptacle with wire terminals and spring clips to hold the projecting fingers of the socket part. These fingers hold the dielectric film. The receptacle fits in the porcelain heads Style No. 338051 and Style No. 338052. Screws and nuts for holding the receptacle in place are included with the porcelain heads.

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
Receptacle and socket, mogul screw base.....	341135	1 1/4	\$1 95
Receptacle only.....	334754	1/2	95
Socket part only, mogul screw base.....	352937	1/2	1 00
Socket part only, medium screw base.....	334945	1/2	1 00
Package of 50 films.....	334755	...	2 40

Lamp Grip Multiple Sockets



MEDIUM SCREW BASE LAMP GRIP SOCKET

Lamp Grip sockets are equipped with two vertical springs which engage the threads of the lamp collar, re-enforce the socket shells and relieve the tension. These vertical springs grip the lamp base and prevent the lamp from working loose when subjected to vibration and the contraction and expansion caused by the variations in temperature.

The terminals have ample capacity and are easily accessible.

The use of these sockets will greatly reduce lamp breakage and outages.

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
Medium screw base.....	334749	1	\$0 85
Mogul screw base.....	334751	1 1/4	95

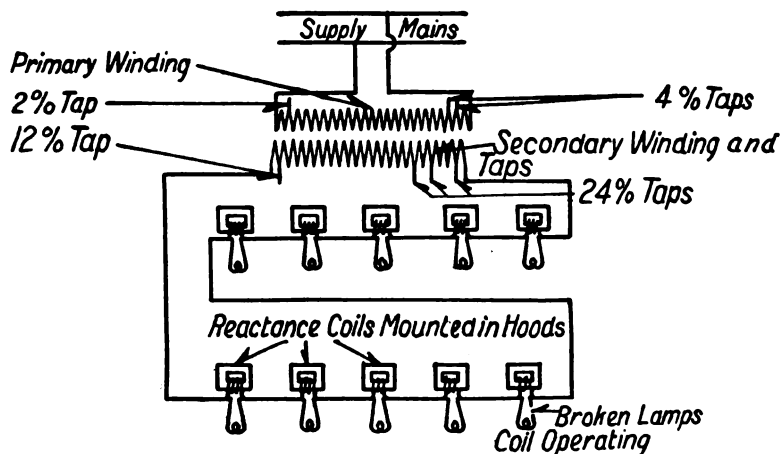
Order by Style Number

## ADJUSTER-SOCKET SYSTEMS

The adjuster-socket system operates only on constant-potential circuits. It consists of a simple series of lamps connected across constant-potential alternating-current mains, or across the secondary terminals of a constant-potential transformer. A reactance coil is connected in shunt across the terminals of each lamp and operates in a well-known manner to maintain the continuity and normal voltage of the circuit in case of burnouts or lamp removals.

**Reactance Coil**—The reactance coil is one of the simplest and most economical devices ever developed for maintaining the continuity of a lamp circuit. It has an effective reactance voltage

equivalent to the voltage of a burning lamp, but the loss of energy sustained by its use is only about 4 or 5 per cent of that taken by a lamp. Taking this loss into consideration, the adjuster-socket system has an efficiency of 95 or 96 per cent with all lamps burning. The coils are so designed that lamps of increased efficiency can be used without change. The drop created by the coil when a lamp is out is such that the current is not greatly altered until about 20 per cent of the lamps on the circuit are out. Lamps of larger candlepower may be used with the standard reactance coils so long as the voltage per lamp does not greatly exceed the voltage of the lamp for which the coil is listed.



ADJUSTER-SOCKET SYSTEM SHOWING OPERATION OF REACTANCE COILS TO REPLACE LAMPS

**Number of Lamps**—Since the lamps are operated in series from a constant-potential source of supply, all the lamps in one circuit must be of the same ampere capacity, though not necessarily of the same candlepower. The sum of the lamp voltages should equal the supply voltage. Consequently, it is necessary to use a definite number of lamps on a given supply voltage.

**Flexibility**—With the adjuster-socket system, a great flexibility is possible through the use of standard transformers providing several different ranges of voltages for lamp circuits. Where the supply circuit voltage differs from that for which the standard apparatus is listed, or where the number of lamps would be better served by a different range of voltages, special transformers adapted to the existing conditions must be secured.

**Transformers**—On supply circuits up to 550 volts it is possible to connect the lamps in series with a control switch, directly across the mains. On higher voltages, however, the supply mains should ordinarily be properly insulated from the lamp circuits by means of suitable transformers. Transformers for this purpose are regularly furnished for 2200-volt supply circuits. Transformers are provided with weatherproof cast-iron cases suitable for indoor use, or for outdoor mounting on poles at a distance from the power station.

**Voltage Variations**—Taps should be provided in the primary winding by means of which any secondary voltage may be raised 2, 4, 6, 8 or 10 per cent, if operating on a 2200-volt circuit. By this arrangement any voltage within one per cent of that required by the circuit may be obtained.



## ADJUSTER-SOCKET SYSTEMS—Continued

## CUTTER ADJUSTER-SOCKET STREETHOODS

## Bracket Type

For 400 and 600 Lumen, 6.6 Ampere, Type C Series Lamps\*

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Flat Radial Reflector</b>			
<b>Complete Unit for 1/4-inch Bracket</b> .....	<b>344485</b>	<b>19</b>	<b>\$15 60</b>
Consists of two parts as follows:			
Porcelain head with reactance socket, canopy and reflector holder, for 1/4-inch bracket.....	<b>350550</b>	<b>14</b>	<b>12 90</b>
20-inch flat radial reflector.....	<b>334746</b>	<b>5</b>	<b>2 70</b>
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344486</b>	<b>19</b>	<b>15 60</b>
Consists of two parts as follows:			
Porcelain head with reactance socket, canopy and reflector holder for 1 1/4-inch bracket.....	<b>350548</b>	<b>14</b>	<b>12 90</b>
20-inch flat radial reflector.....	<b>334746</b>	<b>5</b>	<b>2 70</b>



<b>With 18-inch Radial Bowl Reflector</b>			
<b>Complete unit for 1/4-inch Bracket</b> .....	<b>344477</b>	<b>18</b>	<b>15 60</b>
Consists of two parts as follows:			
Porcelain head with reactance socket and canopy for 1/4-inch bracket.....	<b>350550</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>
<b>Complete unit for 1 1/4-inch Bracket</b> .....	<b>344478</b>	<b>18</b>	<b>15 60</b>
Consists of two parts as follows:			
Porcelain head with reactance socket, and canopy for 1 1/4-inch bracket.....	<b>350548</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor</b>			
<b>Complete unit for 1/4-inch Bracket</b> .....	<b>344479</b>	<b>26</b>	<b>21 60</b>
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for 1/4-inch bracket.....	<b>350550</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>
6 1/2-inch Holophane Superlux refractor.....	<b>335987</b>	<b>5</b>	<b>4 20</b>
Hinged refractor holder.....	<b>344352</b>	<b>3</b>	<b>1 80</b>
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344480</b>	<b>26</b>	<b>21 60</b>
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for 1 1/4-inch bracket.....	<b>350548</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>
6 1/2-inch Holophane Superlux refractor.....	<b>335987</b>	<b>5</b>	<b>4 20</b>
Hinged refractor holder.....	<b>344352</b>	<b>3</b>	<b>1 80</b>



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor</b>			
<b>Complete Unit for 1/4-inch Bracket</b> .....	<b>344481</b>	<b>26</b>	<b>21 60</b>
Consists of four parts as follows:			
Porcelain head with reactance socket and canopy for 1/4-inch bracket.....	<b>350550</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>
6 1/2-inch Holophane skirted refractor.....	<b>335980</b>	<b>5</b>	<b>4 20</b>
Hinged refractor holder.....	<b>344352</b>	<b>3</b>	<b>1 80</b>
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344482</b>	<b>26</b>	<b>21 60</b>
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for 1 1/4-inch bracket.....	<b>350548</b>	<b>14</b>	<b>12 90</b>
18-inch radial bowl reflector.....	<b>335940</b>	<b>4</b>	<b>2 70</b>
6 1/2-inch Holophane skirted refractor.....	<b>335980</b>	<b>5</b>	<b>4 20</b>
Hinged refractor holder.....	<b>344352</b>	<b>3</b>	<b>1 80</b>



\*Lamps are not included. The nominal candle power of series lamps is one tenth of the lumen rating.

Order by Style Number

ADJUSTER-SOCKET SYSTEMS—Continued

CUTTER ADJUSTER-SOCKET STREETHOODS—Continued

Bracket Type

For 800 and 1000 Lumen, 6.6 Ampere, Type C Series Lamps\*

Standard Package Quantity 10



Description

Style No.

Ship. Wt. Lbs., Each

List Price Each

With 20-inch Flat Radial Reflector

Complete Unit for 3/4-inch Bracket.....	344495	20	\$16 50
Consists of two parts as follows:			
Porcelain head with reactance socket and canopy for 3/4-inch bracket.....	350551	15	13 80
20-inch flat radial reflector.....	334746	5	2 70
Complete Unit for 1 1/4-inch Bracket.....	344496	20	16 50
Consists of two parts as follows:			
Porcelain head with reactance socket and canopy for 1 1/4-inch bracket.....	350549	15	13 80
20-inch flat radial reflector.....	334746	5	2 70

With 18-inch Radial Bowl Reflector

Complete Unit for 3/4-inch Bracket.....	344487	19	16 50
Consists of two parts as follows:			
Porcelain head with reactance socket and canopy for 3/4-inch bracket.....	350551	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70
Complete Unit for 1 1/4-inch Bracket.....	344488	19	16 50
Consists of two parts as follows:			
Porcelain head with reactance socket and canopy for 1 1/4-inch bracket.....	350549	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor

Complete Unit for 3/4-inch Bracket.....	344489	27	22 50
Consists of four parts as follows:			
Porcelain head with reactance socket and canopy for 3/4-inch bracket.....	350551	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70
6 1/2-inch Holophane Superlux refractor....	335987	5	4 20
Hinged refractor holder.....	344352	3	1 80
Complete Unit for 1 1/4-inch Bracket.....	344490	27	22 50
Consists of four parts as follows:			
Porcelain head with reactance socket, canopy and reflector holder.....	350549	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70
6 1/2-inch Holophane Superlux refractor....	335987	5	4 20
Hinged refractor holder.....	344352	3	1 80

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor

Complete Unit for 3/4-inch Bracket.....	344491	27	22 50
Consists of four parts as follows:			
Porcelain head with reactance socket and canopy for 3/4-inch bracket.....	350551	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70
6 1/2-inch Holophane skirted refractor....	335980	5	4 20
Hinged refractor holder.....	344352	3	1 80
Complete Unit for 1 1/4-inch Bracket.....	344492	27	22 50
Consists of four parts as follows:			
Porcelain head with reactance socket, canopy and reflector holder.....	350549	15	13 80
18-inch radial bowl reflector.....	335940	4	2 70
6 1/2-inch Holophane skirted refractor....	335980	5	4 20
Hinged refractor holder.....	344352	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.

Order by Style Number

## ADJUSTER-SOCKET SYSTEMS—Continued

## CUTTER ADJUSTER-SOCKET STREETHOODS—Continued

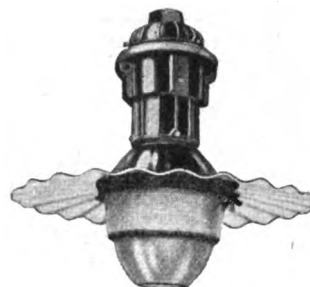
## Bracket Type

For 2500 Lumen, 6.6 Ampere, Type C Series Lamps\*

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector With Extension for Bare Lamps</b>			
Complete unit for ¾-inch bracket.....	344505	23	\$22 50
Consists of two parts as follows:			
Porcelain head with reactance socket, and canopy for ¾-inch bracket.....	350553	18	18 90
20-inch radial bowl reflector with extension....	336153	5	3 60
Complete unit for 1¼-inch bracket.....	344506	23	22 50
Consists of two parts as follows:			
Porcelain head with reactance socket, and canopy for 1¼-inch bracket.....	350552	18	18 90
20-inch radial bowl reflector with extension....	336153	5	3 60
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Superlux Refractor</b>			
Complete Unit for ¾-inch Bracket.....	344497	34	30 00
Consists of four parts as follows:			
Porcelain head with reactance socket and canopy for ¾-inch bracket.....	350553	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Holophane superlux refractor.....	352939	9	6 60
Hinged refractor holder.....	344351	3	1 80
Complete unit for 1¼-inch bracket.....	344498	34	30 00
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for 1¼-inch bracket.....	350552	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Holophane superlux refractor.....	352939	9	6 60
Hinged refractor holder.....	344351	3	1 80
<b>With 18-inch Radial Bowl Reflector and 8½-inch Holophane Skirted Refractor</b>			
Complete unit for ¾-inch bracket.....	344499	33	30 00
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for ¾-inch bracket.....	350553	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Holophane skirted refractor.....	352212	8	6 60
Hinged refractor holder.....	344351	3	1 80
Complete unit for 1¼-inch bracket.....	344500	33	30 00
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for 1¼-inch bracket.....	350552	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Holophane skirted refractor.....	352212	8	6 60
Hinged refractor holder.....	344351	3	1 80
<b>With 18-inch Radial Bowl Reflector and 8½-inch Sol-Lux Diffuser</b>			
Complete unit for ¾-inch bracket.....	344503	30	26 40
Consists of four parts as follows:			
Porcelain head with reactance socket, and canopy for ¾-inch bracket.....	350553	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Sol-Lux diffuser.....	336083	5	3 00
Hinged refractor holder.....	344351	3	1 80
Complete unit for 1¼-inch bracket.....	344504	30	26 40
Consists of four parts follows:			
Porcelain head with reactance socket, and canopy for 1¼-inch bracket.....	350552	18	18 90
18-inch radial bowl reflector.....	335940	4	2 70
8½-inch Sol-Lux diffuser.....	336083	5	3 00
Hinged refractor holder.....	344351	3	1 80

\*Lamps are not included. The nominal candle power of series lamps is one-tenth of the lumen rating.



Order by Style Number

## MULTIPLE SYSTEMS

### CONSTRUCTION OF CUTTER MULTIPLE STREETHOODS

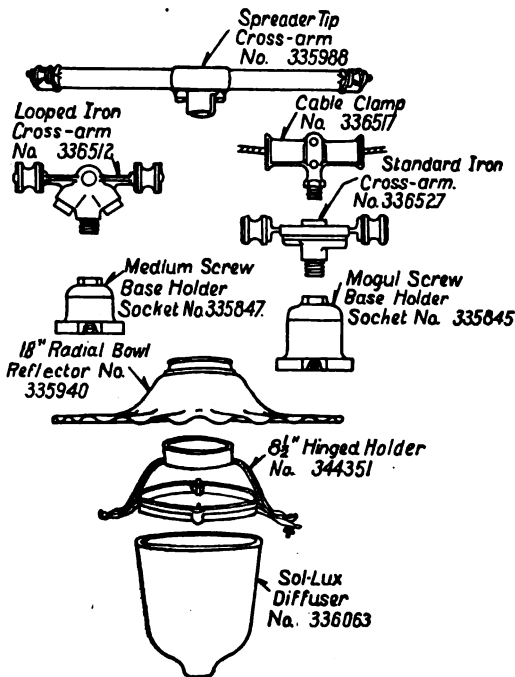
A Cutter Multiple Streethood consists of the Cutter "Easy-to-Wire" Holder-Socket with plain cap and a porcelain enameled reflector with or without diffusing glassware.

The Holder-Socket consists of a porcelain socket with cast iron cap threaded for 1/2 or 3/4-inch pipe or for attachment to center-suspension fittings and a cast iron reflector holder to fit 4-inch standard heel reflectors. The socket is provided with lamp grips to insure perfect electrical connections and prevent the lamps loosening as a result of vibration of the fixture in the wind.

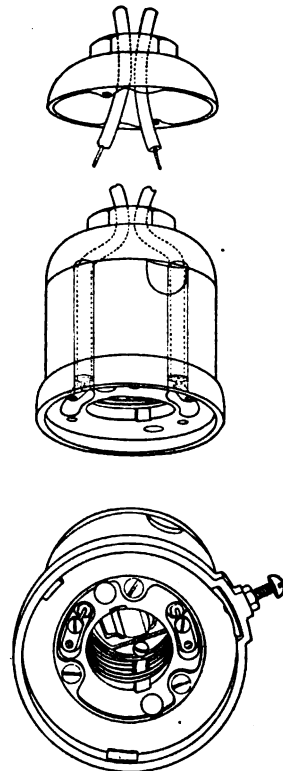
Cutter Multiple Streethoods are "easy-to-wire." The wires are pulled through the cap and connected to the terminals of the socket as shown in the illustration below. The reflector is then attached rigidly by means of a single screw which grips the copper heel of the reflector and is locked in place by nuts. Only three operations are necessary to install a Cutter Multiple Streethood.

Reflectors are made of deep drawing steel and surfaced with three coats of highest grade porcelain enamel, reflective white underneath, green on top. The reflector is supported by a copper heel which insures maximum life because it prevents chipping of the enamel from contact with screw or clip supports. When enamel is chipped away by screws or similar supports, the metal body is exposed to the air; rust sets in and spreads rapidly over the surface of the reflector, reducing its efficiency and greatly shortening its life.

The beaded edge on Cutter Streethood Reflectors is another feature which guarantees maximum life. The edge of the steel reflector body is turned over and a smooth bead is formed. The three coats of enamel on the exterior of the reflector as well as the three coats on the interior are lapped over the beaded edge, forming a protective covering that is extremely durable.



INTERCHANGEABLE PARTS FOR MULTIPLE CENTER-SUSPENSION STREETHOODS



METHOD OF WIRING CUTTER MULTIPLE STREETHOODS

MULTIPLE SYSTEMS—Continued

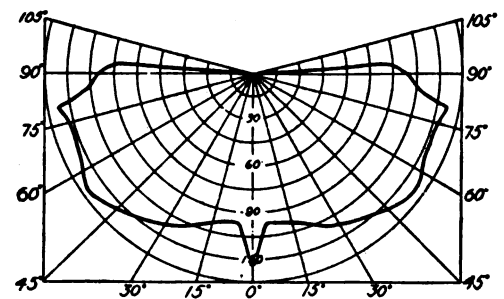
EFFICIENT ILLUMINATION WITH CUTTER MULTIPLE STREETHOODS

The first consideration in the selection of every street-lighting fixture is the amount of light required; that is, the size of lamp. The next consideration is the manner in which the light should be distributed. These determine one or two styles of Streethood Reflectors. The third consideration, that of the method of installation, will enable the customer to select the one best suited to his requirements. Cutter Streethoods and the brackets for supporting them are listed separately. The

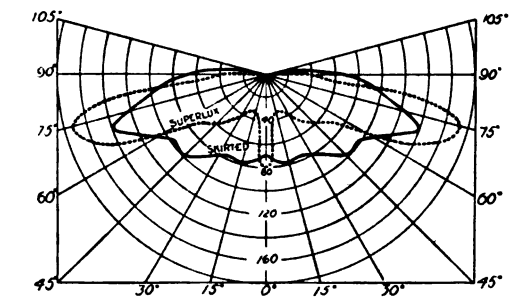
size of lamp is given for each Streethood, which enables the selection of the one best suited to the lighting needs. The Streethood may then be offered in combination with several styles of brackets and center-suspension parts. Thus a complete fixture may be assembled to suit any condition.

To facilitate proper selection of Streethoods typical distribution curves of each reflector are shown below.

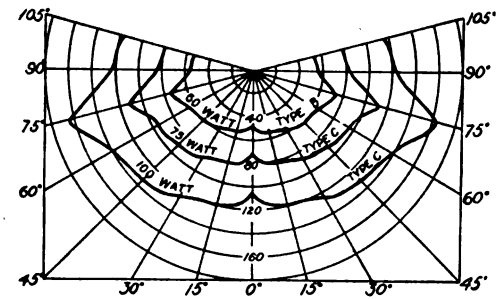
Distribution Curves



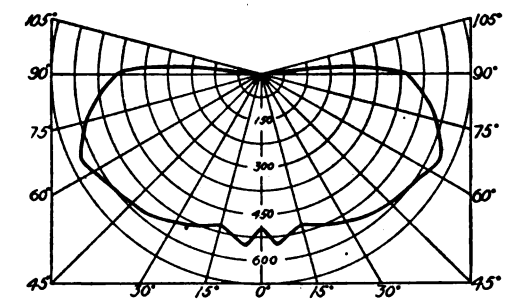
DISTRIBUTION CURVE OF 100-WATT TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR



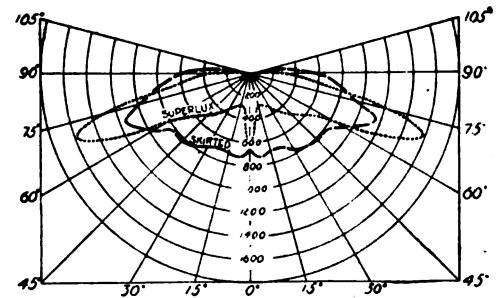
DISTRIBUTION CURVES OF 100-WATT TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR WITH 6 1/2-INCH HOLOPHANE SUPERLUX AND SKIRTED REFRACTORS



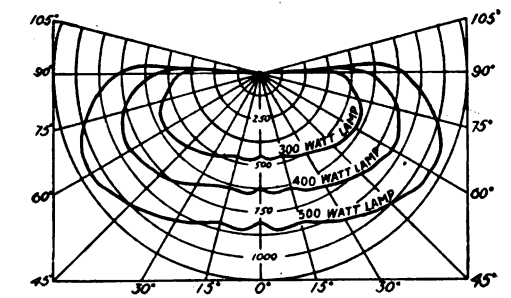
DISTRIBUTION CURVES OF 60-WATT TYPE B LAMP AND 75 AND 100-WATT TYPE C LAMPS WITH 20-INCH FLAT RADIAL REFLECTOR



DISTRIBUTION CURVE OF 300-WATT TYPE C LAMP WITH 20-INCH RADIAL BOWL REFLECTOR WITH EXTENSION



DISTRIBUTION CURVES OF 500-WATT TYPE C LAMP WITH 18-INCH RADIAL BOWL REFLECTOR AND 8 1/2-INCH SUPERLUX AND SKIRTED REFRACTORS



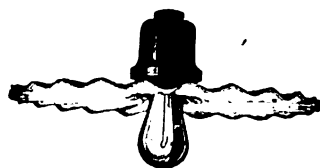
DISTRIBUTION CURVES OF 300, 400 AND 500-WATT TYPE C LAMPS WITH 18-INCH RADIAL BOWL REFLECTOR AND SOL-LUX DIFFUSER

MULTIPLE SYSTEMS—Continued

CUTTER MULTIPLE STREETHOODS

For 50, 75, 100, and 150-Watt Types B and C Multiple Lamps\*

Standard Package Quantity 10



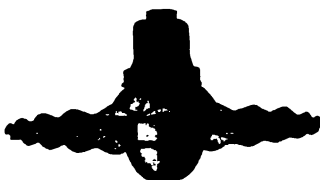
Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Flat Radial Reflector</b>			
Complete Unit for 1/4-inch Bracket .....	344437	8	\$4 75
Consists of two parts as follows:			
Medium Holder Socket with Plain Cap for 1/4-inch Bracket .....	335847	3	2 05
20-inch Flat Radial Reflector .....	334746	5	2 70
Complete Unit for 1 1/4-inch Bracket .....	344751	8	4 75
Consists of two parts as follows:			
Medium Holder Socket with Plain Cap .....	350184	3	2 05
20-inch Flat Radial Reflector .....	334746	5	2 70



<b>For 200-Watt Type C Multiple Lamps</b>			
<b>With 18-inch Radial Bowl Reflector</b>			
Complete Unit for 1/4-inch Bracket .....	336761	7	4 75
Consists of two parts as follows:			
Medium Holder-Socket with Plain Cap .....	335847	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70
Complete Unit for 1 1/4-inch Bracket .....	344747	7	4 75
Consists of two parts as follows:			
Medium Holder-Socket with Plain Cap .....	350184	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor</b>			
Complete Unit for 1/4-inch Bracket .....	344434	15	10 75
Consists of four parts as follows:			
Medium Holder-Socket with Plain Cap .....	335847	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Superlux Refractor .....	335987	5	4 20
Hinged Refractor Holder .....	344352	3	1 80
Complete Unit for 1 1/4-inch Bracket .....	344748	15	10 75
Consists of four parts as follows:			
Medium Holder-Socket with Plain Cap .....	350184	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Superlux Refractor .....	335987	5	4 20
Hinged Refractor Holder .....	344352	3	1 80



<b>With 18-inch Radial Bowl Reflector and 6 1/2-inch Skirted Refractor</b>			
Complete Unit for 1/4-inch Bracket .....	344435	15	10 75
Consists of four parts as follows:			
Medium Holder-Socket with Plain Cap .....	335847	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Skirted Refractor .....	335980	5	4 20
Hinged Refractor Holder .....	344352	3	1 80
Complete Unit for 1 1/4-inch Bracket .....	344749	15	10 75
Consists of four parts as follows:			
Medium Holder-Socket with Plain Cap .....	350184	3	2 05
18-inch Radial Bowl Reflector .....	335940	4	2 70
6 1/2-inch Holophane Skirted Refractor .....	335980	5	4 20
Hinged Refractor Holder .....	344352	3	1 80

\*Lamps are not included.

Order by Style Number

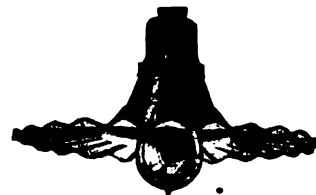
## MULTIPLE SYSTEMS—Continued

## CUTTER MULTIPLE STREETHOODS—Continued

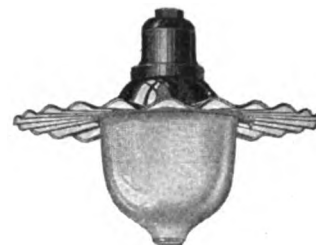
For 200, 300, 400 and 500-Watt Type C Multiple Lamps\*

Standard Package Quantity 10

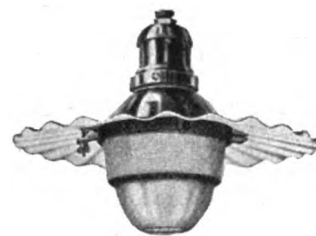
Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
<b>Complete Unit for 3/4-inch Bracket</b> .....	<b>334442</b>	<b>9</b>	<b>\$6 05</b>
Consists of two parts as follows:			
Mogul holder socket with plain cap.....	335845	4	2 45
20-inch radial bowl reflector with extension	336153	5	3 60
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344756</b>	<b>9</b>	<b>6 05</b>
Consists of two parts as follows:			
Mogul holder socket with plain cap.....	335859	4	2 45
20-inch radial bowl reflector with extension	336153	5	3 60



Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
<b>Complete Unit for 3/4-inch Bracket</b> .....	<b>344438</b>	<b>20</b>	<b>13 55</b>
Consists of four parts as follows:			
Mogul screw holder socket with plain cap	335845	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Holophane Superlux refractor....	352939	9	6 60
Hinged refractor holder.....	344351	3	1 80
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344752</b>	<b>19</b>	<b>13 55</b>
Consists of four parts as follows:			
Mogul holder socket with plain cap.....	335859	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Holophane Superlux refractor....	352939	9	6 60
Hinged refractor holder.....	344351	3	1 80



Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
<b>Complete Unit for 3/4-inch Bracket</b> .....	<b>344439</b>	<b>19</b>	<b>13 55</b>
Consists of four parts as follows:			
Mogul screw holder socket with plain cap	335845	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Holophane skirted refractor....	252212	8	6 60
Hinged refractor holder.....	344351	3	1 80
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344753</b>	<b>19</b>	<b>13 55</b>
Consists of four parts as follows:			
Mogul holder socket with plain cap.....	335859	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Holophane skirted refractor....	252212	8	6 60
Hinged refractor holder.....	344351	3	1 80



Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Sol-Lux Diffuser</b>			
<b>Complete Unit for 3/4-inch Bracket</b> .....	<b>344441</b>	<b>16</b>	<b>9 95</b>
Consists of four parts as follows:			
Mogul holder socket with plain cap.....	335845	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Sol-Lux diffuser.....	338063	5	3 00
Hinged refractor holder.....	344351	3	1 80
<b>Complete Unit for 1 1/4-inch Bracket</b> .....	<b>344755</b>	<b>16</b>	<b>9 95</b>
Consists of four parts as follows:			
Mogul holder socket with plain cap.....	335859	4	2 45
18-inch radial bowl reflector.....	335940	4	2 70
8 1/2-inch Sol-Lux diffuser.....	338063	5	3 00
Hinged refractor holder.....	344351	3	1 80



\*Lamps are not included.

Order by Style Number

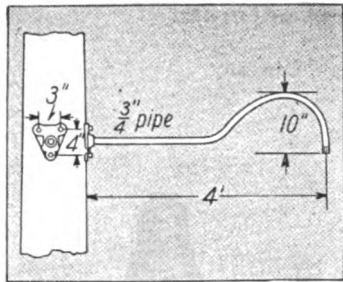
MULTIPLE SYSTEMS—Continued

CUTTER STREETHOOD BRACKETS

3/4 Inch Fitting

Standard Package Quantity 10

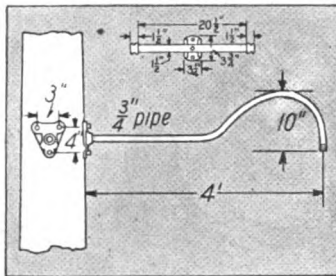
Prices below cover brackets only. Streethood Bodies to make complete Bracket Type Streethoods should be selected from the two preceding pages and ordered separately.



TYPE B BRACKET

Type B Bracket

The type B bracket consists of 4-foot type B gooseneck of 3/4-inch pipe with a 3-hole grooved pole plate, which permits either inner or outer wiring. The holes in the pole plate are 3/8 inch in diameter to take 1/2-inch lag screws.

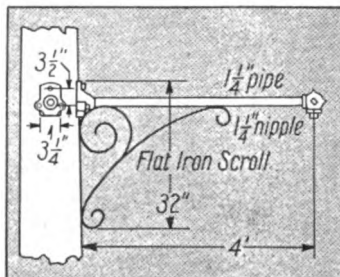


TYPE B BRACKET WITH BRACE ARM

Description	Style No.	Shp. Wt. Lbs. Each	List Price Each
Complete Bracket of 3/4-inch Pipe	340758	10	\$1 75
Consists of two parts as follows:			
3/4-inch x 4-foot Gooseneck	334742	7	1 15
Grooved pole plate	334741	3	80
Complete Bracket of 1/2-inch Pipe	344757	4 1/2	1 25
Consists of two parts as follows:			
1/2-inch x 3-foot Gooseneck	334805	3	90
Grooved pole plate	334881	1 1/2	35

Type B Bracket With Brace Arm

The brace arm is an enameled wood arm with metal bound ends and insulator. It is usually attached to the pole above the bracket and guides the wires to the fixture.

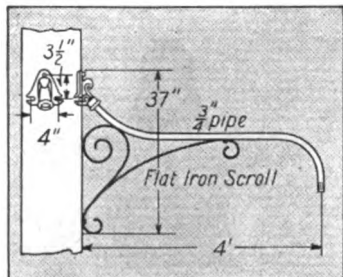


SPARTAN STRAIGHT ARM BRACKET

Complete Bracket	344359	13	2 80
Consists of three parts as follows:			
3/4-inch x 4-foot Gooseneck	334742	7	1 15
Grooved pole plate	334741	3	80
Brace arm	334740	3	1 05
Complete Bracket of 1/2-inch Pipe	344758	7 1/2	2 30
Consists of two parts as follows:			
1/2-inch x 3-foot Gooseneck	334805	3	90
Brace arm	334740	3	1 05
Grooved pole plate	334881	1 1/2	35

Spartan Straight Arm Bracket

The Spartan Straight Arm bracket is made up of a straight length of 1/4-inch pipe with an ornamental headpiece at the outer end, which is equipped with a 3/4-inch nipple for attaching streethood. The 3-hole pole plate which permits inner wiring, is mounted with 1/2-inch lag screws.



MAJESTIC MEDIUM BRACKET

Complete Bracket	338516	24	6 00
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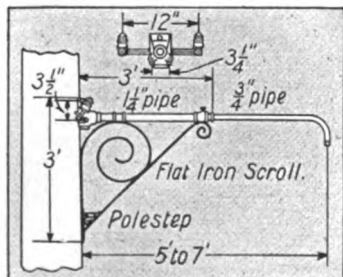
Majestic Medium Bracket

The Majestic Medium bracket is a medium weight bracket of 3/4-inch pipe, with 4 feet overhang. It is equipped with a wrought iron scroll and grooved pole plate, which permits inner wiring. Three 1/2-inch lag screws are used in mounting.

Complete Bracket	335958	15	4 20
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Boulevard Telescope Bracket

The 3/4-inch pipe telescopes into the 1/4-inch pipe and allows for adjustments of 5 to 7 feet in reach from pole. This bracket has a heavy 3-hole cast iron pole plate for inner wiring and a cross arm with glass insulators. The knurled set screw in the pipe joint and the pole step in the lower corner of the scroll are for the convenience of linemen when renewing lamps.



BOULEVARD TELESCOPE BRACKET

Complete Bracket	344360	39	10 10
Consists of four parts as follows:			
Pole plate with cross arm	334775	9	2 00
Boulevard bracket with pole step and scroll assembled	334778	20	5 80
3/4-inch x 5-foot pipe bend	334779	8	2 15
2-pony glass insulator	344825	2	15

**Galvanizing:** When ordered in standard package quantities or over, any of the brackets listed above will be furnished electro-galvanized and painted black, for 20% list additional. In less than standard package quantities add 40%.



MULTIPLE SYSTEMS—Continued

CUTTER STREETHOOD BRACKETS—Continued

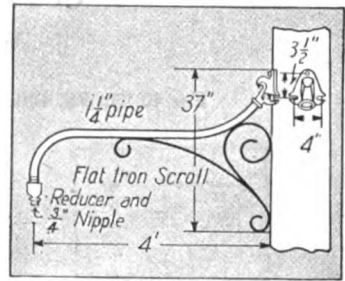
3/4 Inch Fitting

Standard Package Quantity 10

Prices below cover brackets only. Streethood Bodies to make complete Bracket Type Streethoods should be selected from the two preceding pages and ordered separately.

Majestic Senior Bracket

The Majestic Senior bracket consists of a double bend gooseneck of 1 1/4-inch pipe 4 foot long together with a 3-hole grooved pole plate for inner wiring and a wrought iron scroll. Lag screws 1/2-inch diameter are used for mounting on poles.

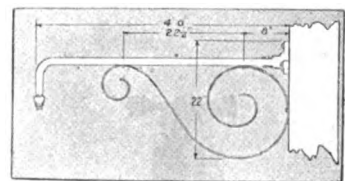


MAJESTIC SENIOR BRACKET

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
Complete Bracket	344443	26 1/4	\$6 55
Consists of three parts as follows:			
Majestic Sr. bracket with scroll assembled	335972	26	6 00
1 1/4 x 3/4-inch reducer	335667	3/8	30
3/4-inch nipple	334826	3/8	25

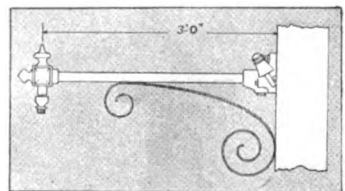
Imperial Bracket

The Imperial bracket is made up of a 4-foot arm of 1 1/4-inch pipe with a right angle bend at the outer end. It is fitted with a 3-hole grooved pole plate and a simple one piece scroll of wrought iron. The holes in the pole plate are 3/8-inch diameter for 1/2-inch lag screws.



IMPERIAL BRACKET

Complete Bracket	353343	24 1/4	6 55
Consists of three parts as follows:			
Imperial Bracket Assembled	352903	24	6 00
1 1/4 x 3/4-inch reducer	335667	1/4	30
3/4-inch nipple	334826	3/8	25

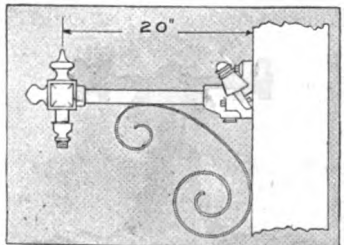


ARCADIAN BRACKET

Arcadian Bracket

A substantial 3-foot bracket made of 1 1/4-inch pipe with 3-hole pole plate, fitted with cross arm and glass insulators. An ornamental headpiece with 1 1/4-inch nipple is used on the outer end and a simple wrought iron scroll acts as a brace.

Complete Bracket	353325	20 1/4	7 95
Consists of five parts as follows:			
Arcadian Bracket assembled	344532	9	5 25
Pole plate with cross arm	334775	9	2 00
2 Pony glass insulators	344825	2	15
1 1/4 x 3/4-inch reducer	335667	1/4	30
3/4-inch nipple	334826	3/8	25



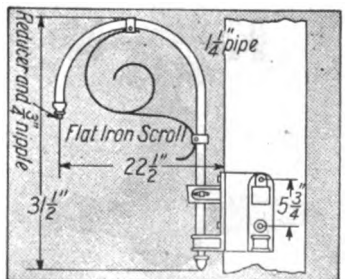
ARCADIAN JR. BRACKET

Arcadian Junior Bracket

Complete Bracket	344445	14	4 65
Consists of three parts as follows:			
Arcadian Junior Bracket assembled	344383	13 3/4	4 10
1 1/4 x 3/4-inch reducer	335667	3/8	30
3/4-inch nipple	334826	3/8	25

Pole Crook

Complete Bracket for Wooden Poles	344446	28 1/2	7 75
Consists of four parts as follows:			
Crook with scroll assembled	334770	20	5 40
1 1/4 x 3/4-inch reducer	335667	3/8	30
3/4-inch nipple	334826	3/8	25
Pole plate	344767	8	1 80
Complete Bracket for 4-inch Iron Poles	344447	36 1/2	10 15
Consists of four parts as follows:			
Crook with scroll assembled	334770	20	5 40
1 1/4 x 3/4-inch reducer	335667	3/8	30
3/4-inch nipple	334826	1/8	25
2 clamps for 4-inch pipe	344356	9	4 20
Complete Bracket for 4-inch Iron Poles	344448	38 1/2	10 35
Consists of four parts as follows:			
Crook with Scroll assembled	334770	20	5 40
1 1/4 x 3/4-inch reducer	335667	3/8	30
3/4-inch nipple	334826	3/8	25
2 clamps for 5-inch pipe	339227	9	4 40



POLE CROOK

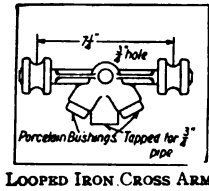
Galvanizing: When ordered in standard package quantities or over, any of the brackets listed above will be furnished electro-galvanized and painted black, for 20% list additional. In less than standard package quantities add 40%.

MULTIPLE SYSTEMS—Continued

CUTTER MULTIPLE STREETHOODS

With Looped Iron Cross Arm

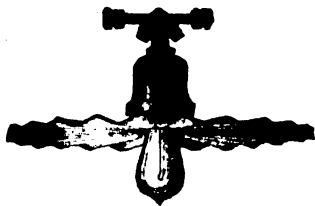
For 40, 60, 75, 100, 150 and 200-Watt Types B and C Multiple Lamps\*



LOOPED IRON CROSS ARM

Loop Suspension Streethoods consist of streethoods with looped iron cross arm Style No. 336512, for attachment to 3/4-inch holder-socket. Designed for use with mast arms, pulleys, etc. When so used, the streethood may be lowered to ground easily for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material).

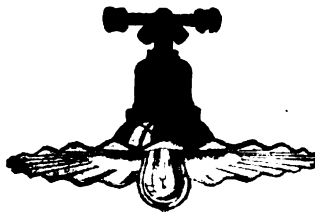
Standard Package Quantity 10



Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
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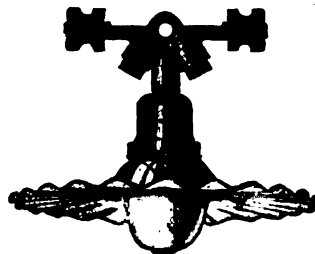
With 20-inch Flat Radial Reflector

Complete Streethood . . . . .	344553	10	\$6 75
Consists of three parts as follows:			
Looped iron cross arm . . . . .	336512	3	2 00
Medium holder socket with plain cap . . . . .	335847	2	2 05
20-inch flat radial reflector . . . . .	334746	5	2 70



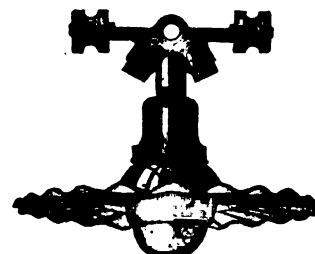
With 18-inch Radial Bowl Reflector

Complete Streethood . . . . .	344449	9	6 75
Consists of three parts as follows:			
Looped iron cross arm . . . . .	336512	3	2 00
Medium holder socket with plain cap . . . . .	335847	2	2 05
18-inch radial bowl reflector . . . . .	335940	4	2 70



With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor

Complete Streethood . . . . .	344450	17	12 75
Consists of five parts as follows:			
Looped iron cross arm . . . . .	336512	3	2 00
Medium holder socket with plain cap . . . . .	335847	2	2 05
18-inch radial bowl reflector . . . . .	335940	4	2 70
6 1/2-inch Holophane Superlux refractor . . . . .	335987	5	4 20
Hinged refractor holder . . . . .	344352	3	1 80



With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor

Complete Streethood . . . . .	344551	17	12 75
Consists of five parts as follows:			
Looped iron cross arm . . . . .	336512	3	2 00
Medium holder socket with plain cap . . . . .	335847	2	2 05
18-inch radial bowl reflector . . . . .	335940	4	2 70
6 1/2-inch Holophane skirted refractor . . . . .	335980	5	4 20
Hinged refractor holder . . . . .	344352	3	1 80

\*Lamps are not included.

Order by Style Number

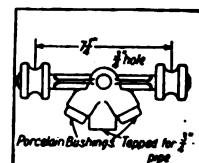
MULTIPLE SYSTEMS—Continued

CUTTER MULTIPLE STREETHOODS—Continued

With Looped Iron Cross Arm

For 200, 300, 400 and 500-Watt Type C Multiple Lamps\*

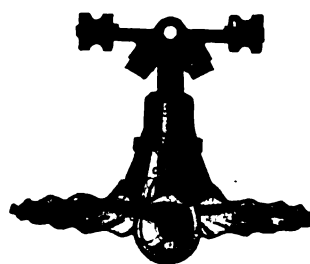
Loop Suspension Streethoods consist of streethoods with looped iron cross arm Style No. 336512, for attachment to 3/4-inch holder-socket. Designed for use with mast arms, pulleys, etc. When so used, the streethood may be lowered to ground easily for renewing lamps and cleaning glassware. (See listing of Mast Arms, Pulleys, Insulators and Pole Line Material.)



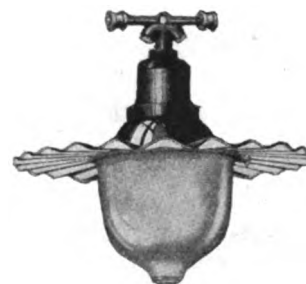
LOOPED IRON CROSS ARM

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood .....	344458	12	\$8 05
Consists of three parts as follows:			
Looped iron cross arm .....	336512	3	2 00
Mogul holder-socket with plain cap .....	335845	4	2 45
20-inch radial bowl reflector with extension .....	338153	5	3 60



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor</b>			
Complete Streethood .....	344454	23	15 55
Consists of five parts as follows:			
Looped iron cross arm .....	336512	3	2 00
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Holophane superlux refractor .....	352939	9	6 60
Hinged refractor holder .....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor</b>			
Complete Streethood .....	344455	22	15 55
Consists of five parts as follows:			
Looped iron cross arm .....	336512	3	2 00
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Holophane skirted refractor .....	252212	8	6 60
Hinged refractor holder .....	344351	3	1 80



<b>With 18-inch Radial Bowl Reflector and 8 1/2-inch Sol-Lux Diffuser</b>			
Complete Streethood .....	344457	19	11 95
Consists of five parts as follows:			
Looped iron cross arm .....	336512	3	2 00
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Sol-Lux diffuser .....	338083	5	3 00
Hinged refractor holder .....	344351	3	1 80



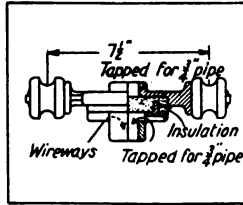
\*Lamps are not included.

Order by Style Number

MULTIPLE SYSTEMS—Continued

**CUTTER MULTIPLE STREETHOODS—Continued**  
**With Cable Grip Suspension**

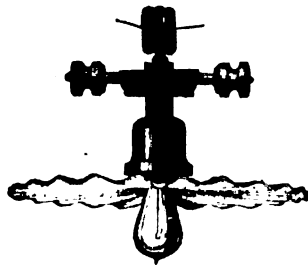
For 40, 60, 75, 100, 150 and 200-Watt Types B and C Multiple Lamps\*



STANDARD IRON CROSS ARM

Cable Grip Suspension Streethoods consist of streethoods with cable clamp, and standard iron cross arm. The streethood is fastened rigidly to the cable clamp, thus insuring that the fixture will always hang level regardless of the tension on the line wires. The cable clamp also compensates for unequal sag in the cable.

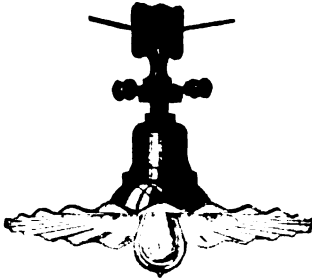
Standard Package Quantity 10



Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
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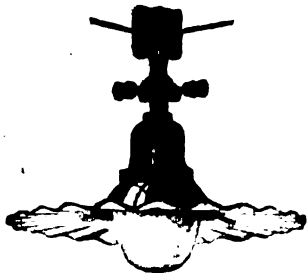
With 20-inch Flat Radial Reflector

Complete Streethood	344463	13	\$7 40
Consists of four parts as follows:			
Cable clamp	336517	3	75
Standard iron cross arm	336527	3	1 90
Medium holder-socket with plain cap	335847	2	2 05
20-inch flat radial reflector	334746	5	2 70



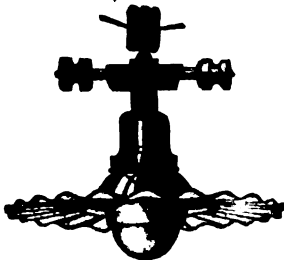
With 18-inch Radial Bowl Reflector

Complete Streethood	344459	12	7 40
Consists of four parts as follows:			
Cable clamp	336517	3	75
Standard iron cross arm	336527	3	1 90
Medium holder-socket with plain cap	335847	2	2 05
18-inch radial bowl reflector	335940	4	2 70



With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor

Complete Streethood	344460	20	13 40
Consists of six parts as follows:			
Cable clamp	336517	3	75
Standard iron cross arm	336527	3	1 90
Medium holder-socket with plain cap	335847	2	2 05
18-inch radial bowl reflector	335940	4	2 70
6 1/2-inch Holophane Superlux refractor	335987	5	4 20
Hinged refractor holder	344352	3	1 80



With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor

Complete Streethood	344461	20	13 40
Consists of six parts as follows:			
Cable clamp	336517	3	75
Standard iron cross arm	336527	3	1 90
Medium holder-socket with plain cap	335847	2	2 05
18-inch radial bowl reflector	335940	4	2 70
6 1/2-inch skirted Holophane refractor	335980	5	4 20
Hinged refractor holder	344352	3	1 80

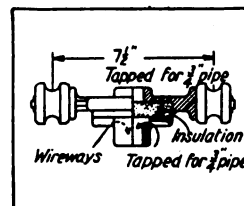
\*Lamps are not included

MULTIPLE SYSTEMS—Continued

**CUTTER MULTIPLE STREETHOODS—Continued**  
**With Cable Grip Suspension**

For 200, 300, 400 and 500-Watt Type C Multiple Lamps\*

Cable Grip Suspension Streethoods consist of Streethoods with cable clamp, and standard iron cross arm. The streethood body is fastened rigidly to the cable clamp, thus insuring that the fixture will always hang level regardless of the tension on the line-wires. The cable clamp also compensates for unequal sag in the cable.



STANDARD IRON CROSS ARM

Standard Package Quantity 10

Description	Style No.	Shp. Wt. Lbs. Each	List Price Each
<b>With 20-inch Radial Bowl Reflector with Extension for Bare Lamps</b>			
Complete Streethood .....	344468	15	\$8 70
Consists of four parts as follows:			
Cable clamp .....	336517	3	75
Standard iron cross arm .....	336527	3	1 90
Mogul holder-socket with plain cap .....	335845	4	2 45
20-inch radial bowl reflector with extension .....	336153	5	3 60

**With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Superlux Refractor**

Complete Streethood .....	344464	26	16 20
Consists of six parts as follows:			
Cable clamp .....	336517	3	75
Standard iron cross arm .....	336527	3	1 90
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Holophane Superlux refractor .....	352839	9	6 60
Hinged refractor holder .....	344351	3	1 80

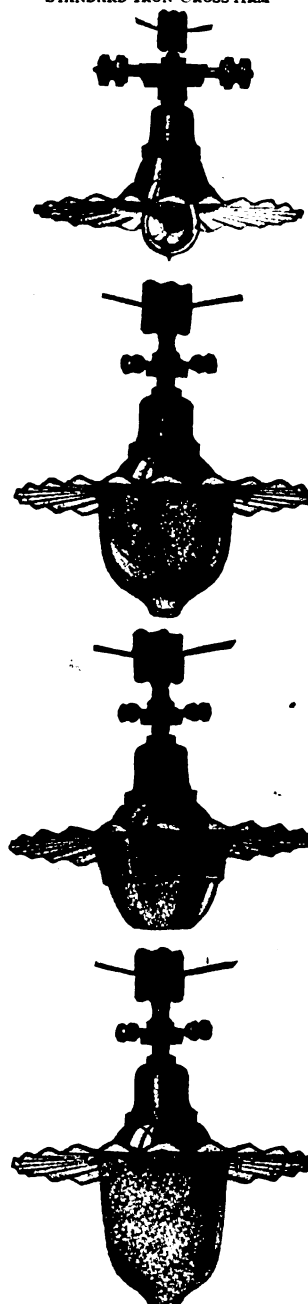
**With 18-inch Radial Bowl Reflector and 8 1/2-inch Holophane Skirted Refractor**

Complete Streethood .....	344465	25	16 20
Consists of six parts as follows:			
Cable clamp .....	336517	3	75
Standard iron cross arm .....	336527	3	1 90
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch skirted Holophane refractor .....	252212	8	6 60
Hinged refractor holder .....	344351	3	1 80

**With 18-inch Radial Bowl Reflector and 8 1/2-inch Sol-Lux Diffuser**

Complete Streethood .....	344467	22	12 60
Consists of six parts as follows:			
Cable clamp .....	336517	3	75
Standard iron cross arm .....	336527	3	1 90
Mogul holder-socket with plain cap .....	335845	4	2 45
18-inch radial bowl reflector .....	335940	4	2 70
8 1/2-inch Sol-Lux Diffuser .....	336063	5	3 00
Hinged refractor holder .....	344351	3	1 80

\*Lamps are not included.



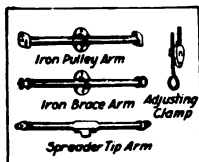
7-329A

MULTIPLE SYSTEMS—Continued

CUTTER MULTIPLE STREETHOODS—Continued

With "Always Level" Suspension

For 50, 75, 100, and 150-Watt Types B and C Multiple Lamps\*

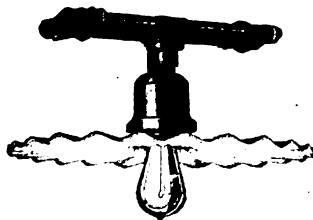


"Always Level" Streethoods consist of Cutter Streethood bodies with Spreader Tip Cross Arm, Iron Pulley Arm, Iron Brace Arm and Adjusting Clamps. The two line wires leading from the brace arm to the hood make up one side of the suspension, while cords passing over covered pulleys form the other side. Adjusting clamps at the end of each cord are independently drawn up taut and locked together.

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price Each
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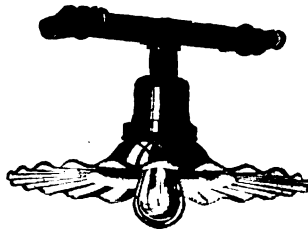
With 20-inch Flat Radial Reflector



Complete Streethood.....	344475	29	\$11 05
Consists of six parts as follows:			
Spreader Tip Cross Arm.....	335988	3	2 05
Medium Holder-Socket with Plain Cap.....	335847	2	2 05
20-inch Flat Radial Reflector.....	334746	5	2 70
Iron Pulley Arm.....	334904	6	2 30
Iron Brace Arm.....	334906	6	1 55
2 Adjusting Clamps.....	334905	1/2	40

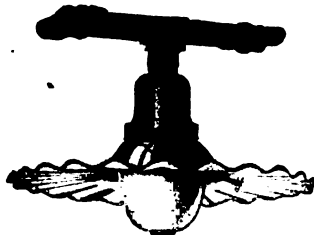
For 200-Watt Type C Multiple Lamps

With 18-inch Radial Bowl Reflector



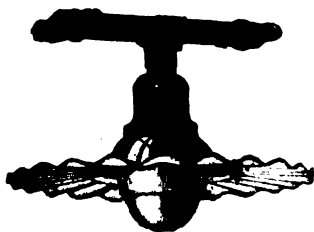
Complete Streethood.....	344471	22	11 05
Consists of six parts as follows:			
Spreader Tip Cross Arm.....	335988	3	2 05
Medium Holder-Socket with Plain Cap.....	335847	2	2 05
18-inch Radial Bowl Reflector.....	335940	4	2 70
Iron Pulley Arm.....	334904	6	2 30
Iron Brace Arm.....	334906	6	1 55
2 Adjusting Clamps.....	334905	1/2	40

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Superlux Refractor



Complete Streethood.....	344472	30	17 05
Consists of eight parts as follows:			
Spreader Tip Cross Arm.....	335988	3	2 05
Medium Holder-Socket with Plain Cap.....	335847	2	2 05
18-inch Radial Bowl Reflector.....	335940	4	2 70
6 1/2-inch Holophane Superlux Refractor.....	335987	5	4 20
Hinged Refractor Holder.....	344352	3	1 80
Iron Pulley Arm.....	334904	6	2 30
Iron Brace Arm.....	334906	6	1 55
2 Adjusting Clamps.....	334905	1/2	40

With 18-inch Radial Bowl Reflector and 6 1/2-inch Holophane Skirted Refractor



Complete Streethood.....	344473	30	17 05
Consists of eight parts as follows:			
Spreader Tip Cross Arm.....	335988	3	2 05
Medium Holder-Socket with Plain Cap.....	335847	2	2 05
18-inch Radial Bowl Reflector.....	335940	4	2 70
6 1/2-inch Holophane Skirted Refractor.....	335980	5	4 20
Hinged Refractor Holder.....	344352	3	1 80
Iron Pulley Arm.....	334904	6	2 30
Iron Brace Arm.....	334906	6	1 55
2 Adjusting Clamps.....	334905	1/2	40

\*Lamps are not included.

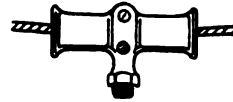
Order by Style Number

MULTIPLE SYSTEMS—Continued

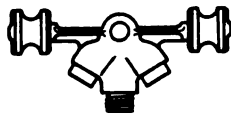
PARTS FOR MULTIPLE STREETHOODS



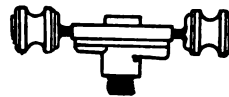
Spreader Tip Cross-arm  
No. 335988



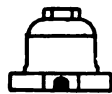
Cable Clamp  
No. 336517



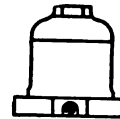
Looped Iron Cross arm  
No. 336512



Standard Iron  
Cross-arm  
No. 336527



Medium  
Holder Socket No. 335847



Mogul  
Holder Socket  
No. 335845

INTERCHANGEABLE PARTS FOR MULTIPLE STREETHOODS



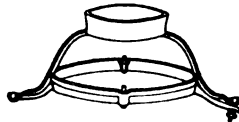
20-INCH FLAT RADIAL REFLECTOR FOR  
40, 60, AND 75-WATT TYPE B  
MULTIPLE LAMPS



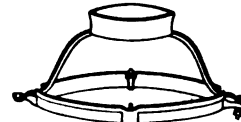
18-INCH RADIAL BOWL REFLECTOR FOR  
100, 150 AND 200-WATT TYPE C  
MULTIPLE LAMPS



20-INCH RADIAL BOWL REFLECTOR WITH  
EXTENSION FOR 200, 300, 400 AND 500-  
WATT TYPE C MULTIPLE LAMPS



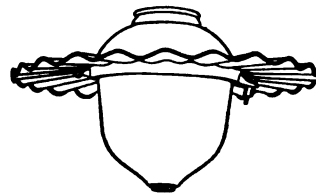
6 1/2-INCH HINGED REFRACTOR HOLDER



8 1/2-INCH HINGED REFRACTOR HOLDER



18-INCH RADIAL BOWL REFLECTOR  
WITH 6 1/2-INCH HOLOPHANE SKIRTED  
REFRACTOR FOR 100 AND 150-WATT  
TYPE C MULTIPLE LAMPS



18-INCH RADIAL BOWL REFLECTOR  
WITH 8 1/2-INCH HOLOPHANE SUPERLUX  
REFRACTOR FOR 200, 300, 400 AND 500-  
WATT TYPE C MULTIPLE LAMPS

Description	Style No.	Ship. Wt. Lbs. Each	List Price
Medium Holder-Socket with plain cap for 3/4-inch pipe.....	335847	2	\$2 05
Mogul Holder-Socket with plain cap for 1/2-inch pipe.....	335845	4	2 45
Mogul screw to medium screw Adjuster.....	336213	1/4	1 30
20-inch Flat Radial Reflector.....	334746	5	2 70
18-inch Radial Bowl Reflector.....	335940	4	2 70
20-inch Radial Bowl Reflector with extension.....	336153	5	3 60
6 1/2-inch Holophane Bowl Refractor.....	335967	5	4 20
6 1/2-inch Holophane Skirted Refractor.....	335980	5	4 20
8 1/2-inch Holophane Superlux Refractor.....	352939	9	6 60
8 1/2-inch Holophane Skirted Refractor.....	252212	8	6 60
8 1/2-inch Sol-Lux Diffuser.....	336063	5	3 00
6 1/2-inch hinged Refractor Holder.....	344352	3	1 80
8 1/2-inch hinged Refractor Holder.....	344351	3	1 80
Looped Iron Cross Arm.....	336512	3	2 00
Cable Clamp.....	336517	3	75
Standard Iron Cross Arm.....	336527	3	1 90
Spreader Tip Cross Arm.....	335988	3	2 05
Iron Pulley Arm.....	334906	6	1 55
Adjusting Clamp.....	334905	1/4	40

Order by Style Number

## PARTS OF STREETHOOD BRACKETS

Standard Package Quantity 10



TYPE A GOOSENECK



TYPE B GOOSENECK

DESCRIPTION Length	Size	STYLE No.		Ship. Wt. Lbs. Each	List Price
		Type A	Type B		
<b>Goosenecks</b>					
3	3/4	334965	334905	2 3/4	\$ 90
4	1 1/2	334988	334885	3 3/4	1 00
5	1 1/2	334866	334869	4 3/4	1 10
3	3/4	334970	334971	3 3/4	95
4	3/4	334902	334742	4 3/4	1 15
5	3/4	344972	334868	5 3/4	1 30

Description	Style No.	Ship. Wt. Lbs. Each	List Price
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### Curved Pole Plates

Grooved for 1/2-inch pipe.....	334881	1 1/4	\$0 35
Grooved for 3/4-inch pipe.....	334741	2 1/4	60

### Wall Flanges

Threaded for 1/2-inch pipe.....	334791	1	40
To slip over 1/2-inch pipe.....	334884	1	40
Threaded for 3/4-inch pipe.....	334983	2	55
To slip over 3/4-inch pipe.....	334890	2	55



1/2-INCH GROOVED  
POLE PLATE



3/4-INCH GROOVED  
POLE PLATE



1/2-INCH WALL  
FLANGE



CORNER  
PLATE



HOOD  
INSULATOR

### Corner Plates

For 1/2-inch pipe.....	336047	2 1/2	1 20
For 3/4-inch pipe.....	336046	2 1/2	1 30

### Hood Insulators

With 1/2-inch stud below, tapped for 3/4-inch pipe above.....	334869	2 1/4	1 50
With 3/4-inch stud below, tapped for 1/2-inch pipe above.....	334867	2 1/4	1 40

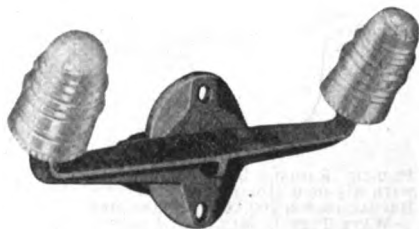


STANDARD BRACE ARM

### Standard Brace Arms

Made of enameled wood with metal bound ends.

With curved pole plate and insulators.....	334740	3	1 05
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ANGLE CHANGE BRACE ARM

### Angle Change Brace Arms

Made of cast iron with curved pole plate and fixed pins. May be used on front or back of pole.

Without glass insulators.....	335985	4	1 50
With glass insulators.....	341155	6	1 65



STANDARD IRON CROSS ARM

### Standard Iron Cross Arms

Made of cast iron with porcelain insulators. Has wire holes beneath. Tapped for either 1/2-inch or 3/4-inch pipe above, 3/4-inch nipple below. Complete with nipple.

For 1/2-inch pipe.....	335983	3	1 90
For 3/4-inch pipe.....	336527	3	1 90



SMIPLE CROSS ARM

### Simple Cross Arms

Without locknut.....	336944	1 1/2	60
With 3/4-inch locknut.....	336639	1 1/2	70
With 1 1/4-inch locknut.....	344372	1 1/2	70

Order by Style Number

7-332A



## INVERTED CONE STREETHOODS

**For 400, 600, 800 and 1000 Lumen Type C Series Lamps  
200 Watt and Smaller Multiple Lamps**

Inverted Cone Streethoods consist of two enameled steel spinnings, a hood fork and a socket. The upper piece of the hood is made in two sizes, 18-inch and 22-inch diameter. The lower piece of the reflector is interchangeable with either size hood. Two finishes are used, baked paint enamel and porcelain enamel. The top of the streethood is green and the reflecting surface is white. A 3/4-inch male nipple is a part of the hood fork extending through the top of the hood. When the inverted cone streethood is to be mounted on a bracket a hood flange listed below should be ordered.



22-INCH INVERTED CONE  
STREETHOOD

### COMPLETE STREETHOODS

Standard Package Quantity 10

Description	Style No.	Ship. Wt. Lbs., Each	List Price
<b>18-inch Hood, Paint Enamel Finish</b>			
With medium screw socket.....	341215	5 1/4	\$3 95
With mogul screw socket.....	341316	5 1/4	4 05
With Regent film socket.....	341317	6	5 05
With standard film socket.....	341331	6	5 05
Without socket.....	341318	4 1/4	3 10
<b>18-inch Hood, Porcelain Enamel Finish</b>			
With medium screw socket.....	341319	6 1/4	5 55
With mogul screw socket.....	341320	7	5 65
With Regent film socket.....	341321	7 1/4	6 65
With standard film socket.....	341332	7 1/4	6 65
Without socket.....	341322	6	4 70
<b>22-inch Hood, Paint Enamel Finish</b>			
With medium screw socket.....	341323	7 3/4	4 35
With mogul screw socket.....	341324	8	4 45
With Regent film socket.....	341325	8 1/4	5 45
With Standard film Socket.....	341333	8 1/4	5 45
Without socket.....	341326	7	3 50
<b>22-inch Hood, Porcelain Enamel Finish</b>			
With medium screw socket.....	341327	9 1/4	6 80
With mogul screw socket.....	341328	10	6 90
With Regent film socket.....	341329	10 1/4	7 90
With standard film socket.....	341334	10 1/4	7 90
Without socket.....	341330	9	5 95
<b>Extra Parts</b>			
Hood flange for 1/2-inch pipe, 3/4-inch nipple.....	335939	1/2	35
Hood flange for 3/4-inch pipe.....	335938	1/2	35
18-inch hood, paint enameled.....	335945	2 3/8	1 20
18-inch hood, porcelain enameled.....	335946	3	2 25
22-inch hood, paint enameled.....	335951	4 1/4	1 60
22-inch hood, porcelain enameled.....	335952	6 1/4	3 50
Reflector, paint enameled.....	335954	2 1/8	1 35
Reflector, porcelain enameled.....	335955	2 1/8	1 90
Hood fork, 3/4-inch rigid nipple.....	335959	1/4	40
Reflector supporting bolts. (2 required per fixture) per pair.....	341336	...	15

### BRACKETS FOR INVERTED CONE STREETHOODS

Standard Package Quantity 10

#### Standard Brackets

A 3-foot goose neck of 1/2-inch pipe with pole plate and cross arm.

Description	Style No.	Wt. Lbs.	List Price
With brace arm.....	341530	10	\$4 20
Without brace arm.....	341531	7	3 15

#### Inner Wired Brackets

A 3-foot goose neck of 1/2-inch pipe with pole plate and hood flange.

With brace arm.....	341548	8 1/2	2 65
Without brace arm.....	341549	5 1/2	1 60

#### Majestic Junior Brackets

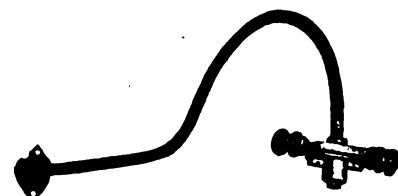
Similar to Majestic Medium Bracket as listed under Multiple Systems but made of 1/2-inch pipe. Extends 3 feet from the pole.

With hood flange.....	341550	15 1/4	4 25
Without hood flange.....	335981	15	3 90

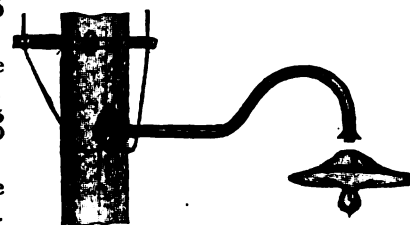
#### Spartan Junior Brackets

Similar to Spartan Straight Arm Bracket listed under Multiple Systems but made of 1/2-inch pipe. Extends 3 feet from the pole.

With hood flange.....	341551	12 1/4	3 20
Without hood flange.....	335905	12	2 85



STANDARD BRACKET



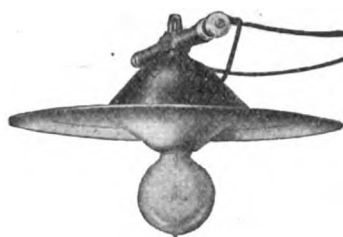
INNER-WIRED BRACKET

INVERTED CONE STREETHOODS—Continued

Standard Package Quantity 10

LOOPED HOODS

A looped hood consists of an inverted cone streethood body and a looped cross-arm.

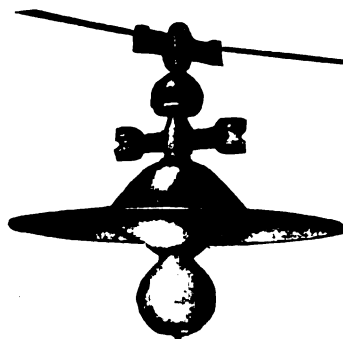


LOOPED HOOD

Description	Style No.	Ship. Wt. Lbs., Each	List Price
<b>18-inch Hood, Paint Enamel Finish</b>			
With Medium Screw Socket.....	341556	8 1/2	\$5 15
With Mogul Screw Socket.....	341557	8 1/2	5 25
With Regent Film Socket.....	341558		6 45
<b>18-inch Hood, Porcelain Enamel Finish</b>			
With Medium Screw Socket.....	341559	9 1/2	6 75
With Mogul Screw Socket.....	341560	10 1/2	6 85
With Regent Film Socket.....	341561	10 1/2	8 05
<b>22-inch Hood, Paint Enamel Finish</b>			
With Medium Screw Socket.....	341563	10 1/2	5 55
With Mogul Screw Socket.....	341564	11	5 65
With Regent Film Socket.....	341565	11 1/2	6 85
<b>22-inch Hood, Porcelain Enamel Finish</b>			
With Medium Screw Socket.....	341566	12 1/2	8 00
With Mogul Screw Socket.....	341567	13	8 10
With Regent Film Socket.....	341568	13 1/2	9 30

CABLE GRIP SUSPENSION STREETHOODS

A cable grip suspension streethood is a center span fixture with a cross-arm, insulator and cable clamp supporting an inverted cone streethood.



CABLE GRIP SUSPENSION STREETHOOD

<b>18-inch Hood, Paint Enamel Finish</b>			
With Medium Screw Socket.....	341569	14	7 20
With Mogul Screw Socket.....	341570	14 1/2	7 30
With Regent Film Socket.....	341571	14 1/2	8 50
<b>18-inch Hood, Porcelain Enamel Finish</b>			
With Medium Screw Socket.....	341572	15 1/2	8 80
With Mogul Screw Socket.....	341573	15 1/2	8 90
With Regent Film Socket.....	341574	15 1/2	10 10
<b>22-inch Hood, Paint Enamel Finish</b>			
With Medium Screw Socket.....	341575	16 1/2	7 60
With Mogul Screw Socket.....	341576	16 1/2	7 70
With Regent Film Socket.....	341577	16 1/2	8 90
<b>22-inch Hood, Porcelain Enamel Finish</b>			
With Medium Screw Socket.....	341578	18 1/2	10 05
With Mogul Screw Socket.....	341579	18 1/2	10 15
With Regent Film Socket.....	341580	18 1/2	11 35

ALWAYS-LEVEL STREETHOODS

The two wires leading from the brace arm to the hood make up one side of the suspension, while cords passing over covered pulleys form the other side. Adjusting clamps, one at the end of each cord, are independently drawn up taut and locked together. To make up an Always-Level streethood, order a Center Hood and one iron pulley arm, one iron brace arm, and two adjusting clamps as listed below. The hood is the center part only of the Always-Level Street-hood and consists of a spreader tip cross arm and an inverted cone streethood. Prices do not include rope, lamps or wires.



CENTER HOOD USED WITH ALWAYS-LEVEL STREETHOOD

Parts for Always-Level Streethoods

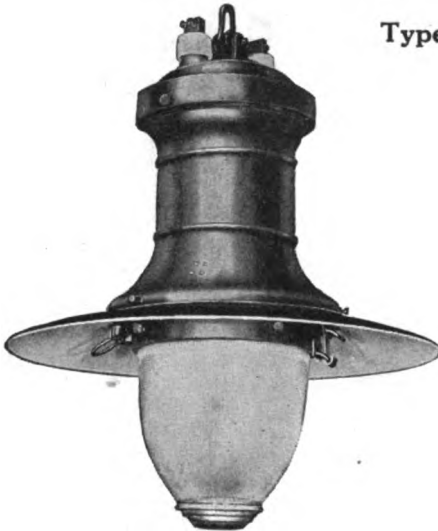
Iron Pulley Arm.....	334904	6	2 35
Iron Brace Arm.....	334906	6	1 55
Adjusting Clamp.....	334905	1/2	45

Center Hoods

18-inch Hood, Paint Enamel Finish				22-inch Hood, Paint Enamel Finish			
	Style No.	Ship Wt. Lbs., Each	List Price		Style No.	Ship. Wt. Lbs., Each	List Price
With Medium Screw Socket...	341581	11	\$6 00	With Medium Screw Socket...	341587	13 1/2	\$6 40
With Mogul Screw Socket....	341582	11 1/2	6 10	With Mogul Screw Socket....	341588	13 1/2	6 50
With Regent Film Socket....	341583	11 1/2	7 80	With Regent Film Socket....	341589	13 1/2	7 70
<b>18-inch Hood, Porcelain Enamel Finish</b>				<b>22-inch Hood, Porcelain Enamel Finish</b>			
With Medium Screw Socket...	341584	12 1/2	7 60	With Medium Screw Socket...	341590	15 1/2	8 85
With Mogul Screw Socket....	341585	12 1/2	7 70	With Mogul Screw Socket....	341591	15 1/2	8 95
With Regent Film Socket....	341586	12 1/2	8 90	With Regent Film Socket....	341592	15 1/2	10 15

## DUST-PROOF LUXSOLITE PENDANTS

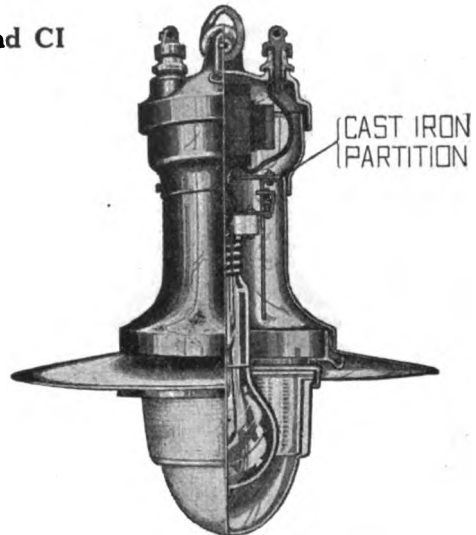
Types C and CI



TYPE C LUXSOLITE PENDANT WITH REFLECTOR AND HOLOPHANE SUPERLUX REFRACTOR

Westinghouse dust-proof Luxsolite Pendants have been designed for lighting residential streets, parks, and other outdoor spaces where high candle-power type C lamps are essential.

Years of experience in the design and operation of street-lighting fixtures, have demonstrated that lamp and auto-transformer should be in separate chambers; the lamp chambers should be dust and bug proof and that containing the auto-transformer should be ventilated. These features are exclusive in Westinghouse Luxsolite Pendants.



SECTIONAL VIEW OF TYPE CI LUXSOLITE PENDANT SHOWING PARTITION BETWEEN CHAMBERS

The body of the pendant consists of a cast iron top supported by a porcelain insulator with hanger-link and a casing. The type C case is of copper and the type CI, of cast iron. Either case can be readily removed from the cast iron top.

**Auto-Transformer**—To secure the full advantage of the high efficiency type C lamp, a larger current is necessary than is usually available in the ordinary series circuit. To obtain this current, a special auto-transformer has been designed. The standard winding is for a 6.6 ampere primary with an extra tap provided for use on 7.5 ampere circuits.



TYPE C LUXSOLITE PENDANT WITH GLOBE LOWERED FOR CLEANING

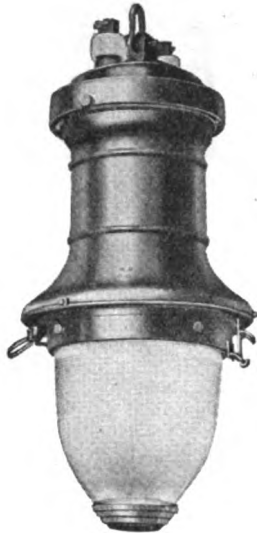
Taps are provided on the standard 10,000-lumen auto-transformer to take care of 6000-lumen 20-ampere lamps and on the standard 6000-lumen auto-transformer to take care of 4000-lumen 15-ampere lamps. Windings for other current ratings may be obtained on order.



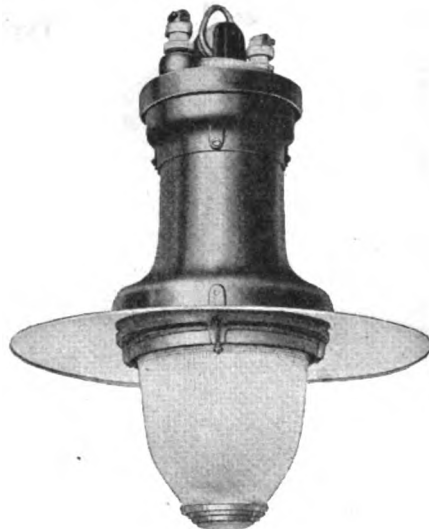
TYPE CI LUXSOLITE PENDANT WITH REFLECTOR AND RECTILINEAR GLOBE

## DUST-PROOF LUXSOLITE PENDANTS—Continued

## Types C and CI—Continued



TYPE C LUXSOLITE PENDANT WITH HOLOPHANE SUPERLUX REFRACTOR



TYPE CI LUXSOLITE PENDANT WITH REFLECTOR AND HOLOPHANE SUPERLUX REFRACTOR

**Film-cutout and Multiple Sockets**—In some cases it is desired to operate Luxsolite Pendants on straight series circuits and on multiple circuits without the use of auto-transformers. In such cases, units with film-cutout series sockets and multiple sockets are used.

**Reflector**—A reflector is ordinarily used and supplied but can be omitted on the type C Pendant if desired. Type CI fixtures are not recommended for use without the reflector. The standard reflector is made of high-grade spinning steel with porcelain enameled finish. A high-efficiency reflective white is used on the under surface.

**Glassware**—The selection of glassware depends upon the conditions and the requirements of the

installation. The new opalescent rectilinear globe is recommended where high efficiency and sparkling appearance is desired. When more diffused light is essential, the Monax Luxsolite globe should be used. With smaller lamps, the Sol-Lux diffuser may be found desirable.

**Refractors**—Refractors of the Superlux type are recommended where broad distribution and uniform illumination over a large area is required. Skirted Refractors may be used where the spacing of units is closer.

All glassware is supported by a holder which is equipped with hinges, thus providing easy access to the lamp and facilitating cleaning.



TYPE C LUXSOLITE PENDANT WITH REFLECTOR AND RECTILINEAR GLOBE



TYPE CI LUXSOLITE PENDANT WITH REFLECTOR AND SOL-LUX DIFFUSER

DUST-PROOF LUXSOLITE PENDANTS—Continued



TYPE C COPPER LUXSOLITE PENDANT WITH  
OPALESCENT RECTILINEAR GLOBE

Type C (Copper)

The casing of the type C copper Luxsolite is divided into two chambers. The upper chamber contains the auto-transformer and is provided with openings for the circulation of air. The lower chamber contains the socket and lamp and is sealed to exclude dirt and insects when glassware which has no bottom opening is used. The Luxsolite globes, both Rectilinear and Monax, as well as the closed Super-Lux and skirted refractor type, have no bottom opening. With glassware of this kind, the collection of dust and dirt inside the globe is prevented and the cost of cleaning reduced to a minimum.

Style number and list price include pendant with 6.6-7.5 ampere auto-transformer, series film socket, or mogul socket, complete with reflector and glassware.

For 4000 Lumen, 15 Ampere Lamps

Description	Style No.	Ship. Wt. Lbs., Each	List Price
<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353860	67	\$29 50
Consists of four parts as follows:			
Type C Body with auto-transformer, mogul socket, and globe seat.....	353880	34	22 40
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Rectilinear opalescent Luxsolite globe.....	350572	24	4 30
<b>With Auto-Transformer and Monax Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353861	67	29 50
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353880	34	22 40
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Monax Luxsolite globe.....	220260A	24	4 30
<b>With Auto-Transformer and 8½-Inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	353863	61	31 80
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353880	34	22 40
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	352940	18	6 60
<b>With Auto-Transformer and 8½-Inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	353862	59	31 80
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353880	34	22 40
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch skirted refractor.....	336793	16	6 60

For 6000 Lumen, 20 Ampere Lamps

<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353864	68	30 90
Consists of four parts as follows:			
Type C body with auto-transformer mogul socket and globe seat.....	353884	35	23 80
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Rectilinear Luxsolite globe.....	350572	24	4 30
<b>With Auto-Transformer and Monax Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353865	68	30 90
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353884	35	23 80
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Monax Luxsolite globe.....	220260A	24	4 30
<b>With Auto-Transformer and 8½-Inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	353867	62	33 20
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353884	35	23 80
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	352940	18	6 60
<b>With Auto-Transformer and 8½-Inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	353866	60	33 20
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353884	35	23 80
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch skirted refractor.....	336793	16	6 60

Order by Style Number

## DUST-PROOF LUXSOLITE PENDANTS—Continued

## Type C (Copper)—Continued

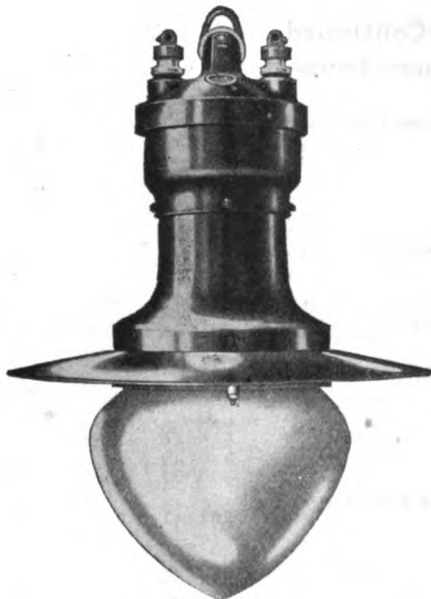
For 10,000 Lumen, 20 Ampere Lamps

Description	Style No.	Ship. Wt. Lbs., Each	List Price
<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353868	72	\$33 70
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353888	39	26 60
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Rectilinear opalescent Luxsolite globe.....	350572	24	4 30
<b>With Auto-Transformer and Monax Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353869	72	33 70
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket, and globe seat.....	353888	39	26 60
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Monax Luxsolite globe.....	220260A	24	4 30
<b>With Auto-Transformer and 8½-Inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	353871	66	36 00
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353888	39	26 60
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	352940	18	6 60
<b>With Auto-Transformer and 8½-Inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	353870	64	36 00
Consists of four parts as follows:			
Type C body with auto-transformer, mogul socket and globe seat.....	353888	39	26 60
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch skirted refractor.....	338793	16	6 60
<b>For Straight Series Lamps, 2500-6000 Lumens</b>			
<b>With Regent Film Socket and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353872	59	24 10
Consists of four parts as follows:			
Type C body with Regent film socket and globe seat.....	353892	26	17 00
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Rectilinear opalescent Luxsolite globe.....	350572	24	4 30
<b>With Regent Film Socket and Monax Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353873	59	24 10
Consists of four parts as follows:			
Type C body with Regent film-socket and globe seat.....	353892	26	17 00
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Monax Luxsolite globe.....	220260	24	4 30
<b>With Regent Film Socket and 8½-Inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	353875	53	26 40
Consists of four parts as follows:			
Type C body with Regent film-socket and globe seat.....	353892	26	17 00
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	352940	18	6 60
<b>With Regent Film Socket and 8½-Inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	353874	51	26 40
Consists of four parts as follows:			
Type C body with Regent film socket and globe seat.....	353892	26	17 00
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	338793	16	6 60
<b>For Multiple Lamps, 300-1000 Watts*</b>			
<b>With Mogul Multiple Socket and Rectilinear Opalescent Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353876	59	23 10
Consists of four parts as follows:			
Type C body with mogul multiple socket and globe seat.....	353896	26	16 00
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Rectilinear opalescent Luxsolite globe.....	350572	24	4 30
<b>With Mogul Multiple Socket and Monax Luxsolite Globe</b>			
<b>Complete Unit</b> .....	353877	59	23 10
Consists of four parts as follows:			
Type C body with mogul multiple socket and globe seat.....	353896	26	16 00
Luxsolite globe holder.....	353306	1	80
20-inch reflector.....	220890	8	2 00
Monax Luxsolite globe.....	220260A	24	4 30
<b>With Mogul Multiple Socket and 8½-Inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	353879	53	25 40
Consists of four parts as follows:			
Type C body with mogul multiple socket and globe seat.....	353896	26	16 00
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch Superlux refractor.....	352940	18	6 60
<b>With Mogul Multiple Socket and 8½-Inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	353878	51	25 40
Consists of four parts as follows:			
Type C body with mogul Multiple socket and globe seat.....	353896	26	16 00
Refractor ring.....	353759	1	80
20-inch reflector.....	220890	8	2 00
8½-inch skirted refractor.....	338793	16	6 60

\*750 and 1000 watt lamps can be used only in pendants with Luxsolite globes.

Order by Style Number

DUST-PROOF LUXSOLITE PENDANTS—Continued



TYPE CI LUXSOLITE FIXTURE, WITH REFLECTOR AND LUXSOLITE GLOBE

Type CI (Cast Iron)

The casing of the type CI Pendant is divided into two chambers by a cast iron partition between the two lower sections. The upper chamber contains the auto-transformer and has openings to permit the circulation of air. The lower chamber contains the socket and lamp, and is sealed to exclude dirt and insects when glassware which has no bottom opening (Luxsolite Globe, Skirted or Superlux Refractor) is used. The collection of dirt and dust inside the globe is, therefore, prevented, and the cost of cleaning minimized.

Style number and list price include pendant complete with 6.6—7.5-ampere primary auto-transformer, series (Regent) film socket, or mogul socket, complete with reflector and glassware.

Description	Style No.	Ship. Wt. Lbs. Each	List Price
<b>For 4000 Lumen, 15 Ampere Lamps</b>			
<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
Complete Unit .....	354161	46½	\$30 50
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353766	34½	23 40
Luxsolite Globe Holder .....	353029	1½	80
20-inch Reflector .....	334798	6½	2 00
Rectilinear Luxsolite Globe .....	350572	.....	4 30
<b>With Auto-Transformer and 8½-inch Superlux Refractor</b>			
Complete Unit .....	351434	49½	32 80
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353766	34½	23 40
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
8½-inch Superlux Refractor .....	352940	9½	6 60
<b>With Auto-Transformer and Sol-Lux Diffuser</b>			
Complete Unit .....	351432	44½	29 20
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353766	34½	23 40
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
Sol-Lux Diffuser .....	338063	4½	3 00
<b>With Auto-Transformer and 8½-inch Skirted Refractor</b>			
Complete Unit .....	351433	48½	32 80
Consists of four parts as follows:			
C. I. Body with Auto-transformer, Mogul Socket and Globe Seat .....	353766	34½	23 40
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
8½-inch Skirted Refractor .....	336793	8½	6 60
<b>For 6000 Lumen, 20 Ampere Lamps</b>			
<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
Complete Unit .....	351462	47½	31 90
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353763	35½	24 80
Luxsolite Globe Holder .....	353029	1½	80
20-inch Reflector .....	334798	4	2 00
Rectilinear Luxsolite Globe .....	350572	6½	4 30
<b>With Auto-Transformer and 8½-inch Superlux Refractor</b>			
Complete Unit .....	351438	59½	34 20
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353763	35½	24 80
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
8½-inch Superlux Refractor .....	352940	8½	6 60
<b>With Auto-Transformer and Sol-Lux Diffuser</b>			
Complete Unit .....	351436	45½	30 60
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat .....	353763	35½	24 80
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
Sol-lux Diffuser .....	338063	4½	3 00
<b>With Auto Transformer and 8½-inch Skirted Refractor</b>			
Complete Unit .....	351437	49½	34 20
Consists of four parts as follows:			
C. I. Body with Auto-Transformer and Mogul Socket and Globe Seat .....	353763	35½	24 80
Refractor Ring .....	353769	1½	80
20-inch Reflector .....	334798	4	2 00
8½-inch Skirted Refractor .....	336793	8½	6 60

Order by Style Number

7-334A

## DUST-PROOF LUXSOLITE PENDANTS—Continued

Type CI (Cast Iron)—Continued  
For 10,000 Lumen, 20 Ampere Lamps

Description	Style No.	Ship. Wt. Lbs. Each	List Price
<b>With Auto-Transformer and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	351463	50	\$34 70
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat.....	353765	38	27 80
Luxsolite Globe Holder.....	353029	1½	80
20-inch Reflector.....	334798	4	2 00
Rectilinear Luxsolite Globe.....	350572	6½	4 30
<b>With Auto-Transformer and 8½-inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	351442	53	37 00
Consists of four parts as follows:			
C. I. Body with Auto-Transformer, Mogul Socket and Globe Seat.....	353765	38	27 80
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	9½	2 00
8½-inch superlux refractor.....	352940	9½	6 60
<b>With Auto-Transformer and Sol-Lux Diffuser</b>			
<b>Complete Unit</b> .....	351440	48	33 40
Consists of four parts as follows:			
C. I. Body with Auto-transformer, Mogul Socket, and Globe Seat.....	353765	38	27 80
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
Sol-lux Diffuser.....	336063	4½	3 00
<b>With Auto-Transformer and 8½-inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	351441	52	37 00
Consists of four parts as follows:			
C. I. Body with Auto-transformer, Mogul Socket, and Globe Seat.....	353765	38	27 80
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
8½-inch Skirted Refractor.....	336793	8½	6 60
<b>For Straight Series Lamps, 2500-6000 Lumens</b>			
<b>With Regent Film Socket and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	351464	37	25 10
Consists of four parts as follows:			
C. I. Body with Regent Film Socket and Globe Seat.....	353767	25	18 00
Luxsolite Globe Holder.....	353029	1½	80
20-inch Reflector.....	334798	4	2 00
Rectilinear Luxsolite Globe.....	350572	6½	4 30
<b>With Regent Film Socket and 8½-inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	351446	40	27 40
Consists of four parts as follows:			
C. I. Body with Regent Film-Socket and Globe Seat.....	353767	25	18 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
8½-inch Superlux Refractor.....	352940	9½	6 60
<b>With Regent Film Socket and Sol-Lux Diffuser</b>			
<b>Complete Unit</b> .....	351444	35	23 80
Consists of Four Parts as Follows:			
C. I. Body with Regent Film-Socket and Globe Seat.....	353767	25	18 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
Sol-lux Diffuser.....	336063	4½	3 00
<b>With Regent Film Socket and 8½-inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	351445	39	27 40
Consists of four parts as follows:			
C. I. Body with Regent Film Socket and Globe Seat.....	353767	25	18 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
8½-inch Superlux Refractor.....	336793	8½	6 60
<b>For Multiple Lamps, 300-1000 Watts*</b>			
<b>With Mogul Multiple Socket and Rectilinear Luxsolite Globe</b>			
<b>Complete Unit</b> .....	351466	37	24 10
Consists of four parts as follows:			
C. I. Body with Mogul Multiple Socket and Globe Seat.....	353768	25	17 00
Luxsolite Globe Holder.....	353029	1½	80
20-inch Reflector.....	334798	4	2 00
Rectilinear Luxsolite Globe.....	350572	6½	4 30
<b>With Mogul Multiple Socket and 8½-inch Superlux Refractor</b>			
<b>Complete Unit</b> .....	351450	40	26 40
Consists of four parts as follows:			
C. I. Body with Mogul Multiple Socket, and Globe Seat.....	353768	25	17 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
8½-inch Superlux Refractor.....	352940	9½	6 60
<b>With Mogul Multiple Socket and Sol-Lux Diffuser</b>			
<b>Complete Unit</b> .....	351448	39	22 80
Consists of four parts as follows:			
C. I. Body with Mogul Multiple Socket, and Globe Seat.....	353768	25	17 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
Sol-lux Diffuser.....	336063	4½	3 00
<b>With Mogul Multiple Socket and 8½-inch Skirted Refractor</b>			
<b>Complete Unit</b> .....	351449	39	26 40
Consists of four parts as follows:			
C. I. Body with Mogul Multiple Socket and Globe Seat.....	353768	25	17 00
Refractor Ring.....	353769	1½	80
20-inch Reflector.....	334798	4	2 00
8½-inch Skirted Refractor.....	336793	8½	6 60

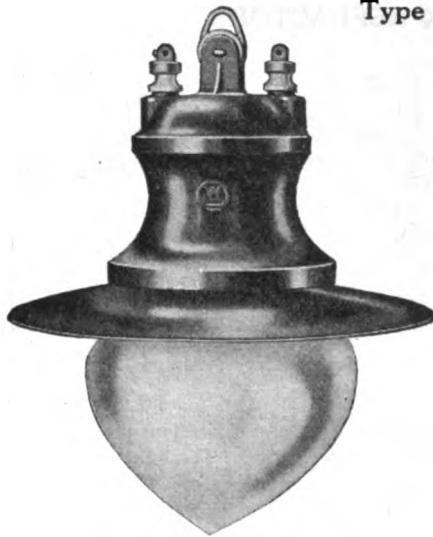
\*750 and 1000 Watt Lamps can be used only in pendants with Luxsolite globes.

Order by Style Number



DUST-PROOF LUXSOLITE PENDANTS—Continued

Type SP (Single Piece)



TYPE SP LUXSOLITE PENDANT WITH LUXSOLITE GLOBE



TYPE SP LUXSOLITE PENDANT WITH SKIRTED REFRACTOR

especially suitable for use where weather conditions require a substantial construction which affords the utmost protection to the lamp and socket.

Application

The type SP Luxsolite pendant is of the same general construction as the CI pendant except that the body is cast in a single piece. The casing is shorter and does not have sufficient space for an auto-transformer; it is, therefore, limited to series film-cutout and multiple service. A dust-proof joint is provided between the glassware and body by means of a felt gasket so that the pendant is not only bug-proof, but dust-proof as well, and the labor of cleaning is thereby minimized. These pendants are

Construction

The casing is made of gray cast iron, galvanized and finished with black asphaltum paint. Its simplicity of design gives great strength and rigidity. The socket support is adjustable and may be varied for different sizes of lamps. The felt gasket is securely glued to the globe seat and the gasket may be readily renewed in case of damage.

Standard Luxsolite binding posts and reflector as shown are regularly furnished. The same glassware listed with the type CI pendants may be used.

For Straight Series Lamps, 2500-6000 Lumens

Description	Style No.	Ship. Wt. Lbs. Each	List Price
<b>With Regent Series Film Socket and Rectilinear Luxsolite Globe</b>			
Complete Unit.....	351458	48 1/2	\$20 60
Consists of four parts as follows:			
S. P. Body with Film Socket and Globe Seat.....	353791	36 1/2	13 50
Luxsolite Globe Holder.....	353029	1 1/2	80
20-inch Reflector.....	334798	4	2 00
Rectilinear Luxsolite Globe.....	350572	6 1/2	4 30
<b>With Regent Series Film Socket and 8 1/2-inch Superlux Refractor</b>			
Complete Unit.....	353421	51	22 90
Consists of four parts as follows:			
S. P. Body with Film Socket and Globe Seat.....	353791	36 1/2	13 50
Refractor Ring.....	353789	1 1/2	80
20-inch Reflector.....	334798	4	2 00
8 1/2-inch Superlux Refractor.....	352940	9	6 60
<b>With Regent Series Film Socket and 8 1/2-inch Skirted Refractor</b>			
Complete Unit.....	351456	50 1/2	22 90
Consists of four parts as follows:			
S. P. Body with Film Socket and Globe Seat.....	353791	36 1/2	13 50
Refractor Ring.....	353789	1 1/2	80
20-inch Reflector.....	334798	4	2 00
8 1/2-inch Skirted Refractor.....	336793	8 1/2	6 60

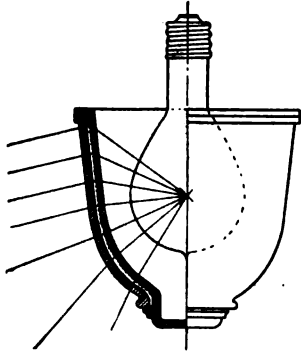
For Multiple Lamps, 300-1000 Watts\*

<b>With Mogul Multiple Socket and Rectilinear Luxsolite Globe</b>			
Complete Unit.....	351457	47 1/2	19 60
Consists of four parts as follows:			
S. P. Body with Mogul Multiple Socket and Globe Seat.....	353792	35 1/2	12 50
Luxsolite Globe Holder.....	353029	1 1/2	80
20-inch Reflector.....	334798	4	2 00
Rectilinear Luxsolite Globe.....	350572	6 1/2	4 30
<b>With Mogul Multiple Socket and 8 1/2-inch Skirted Refractor</b>			
Complete Unit.....	351455	49 1/2	21 90
Consists of four parts as follows:			
S. P. Body with Mogul Multiple Socket and Globe Seat.....	353792	35 1/2	12 50
Refractor Ring.....	353789	1 1/2	80
20-inch Reflector.....	334798	4	2 00
8 1/2-inch Skirted Refractor.....	336793	8 1/2	6 60
<b>With Mogul Multiple Socket and 8 1/2-inch Superlux Refractor</b>			
Complete Unit.....	353422	50	21 90
Consists of four parts as follows:			
S. P. Body with Mogul Multiple Socket and Globe Seat.....	353792	35 1/2	12 50
Refractor Ring.....	353789	1 1/2	80
20-inch Reflector.....	334798	4	2 00
8 1/2-inch Superlux Refractor.....	352940	9	6 60

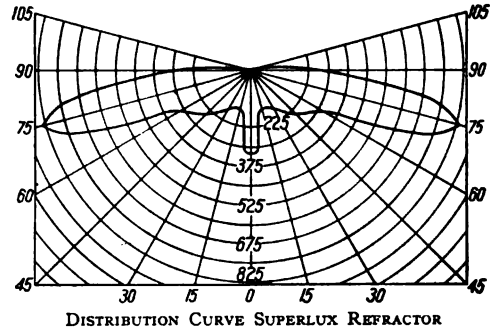
\*750 and 1000 watt Lamps can be used only in pendants with Luxsolite Globes.

DUST-PROOF LUXSOLITE PENDANTS—Continued

HOLOPHANE SUPERLUX REFRACTORS



THE SUPERLUX REFRACTOR



The Holophane Superlux refractor consists of two pieces of pressed crystal glass, nested one within the other and clamped together so as to form a single unit. The inside surface of the inner piece and the outside surface of the outer piece are smooth; so that in the assembled unit, both inside and outside surfaces are smooth, making cleaning easy. The outside surface of the inner piece has horizontal prisms so designed as to bend downward the up-

ward emitted light and to bend upward a part of the light emitted downward. The light emitted downward near the vertical, is redistributed to give a good distribution under the unit. This arrangement of horizontal prisms greatly increases the light emitted at angles between 60 and 85 degrees with the vertical and hence greatly extends the radius of effective illumination, but at the expense of the light which would naturally fall directly under the unit. The inside surface of the outside piece has vertical flutes which, while not materially altering the distribution produced by the inside piece, diffuse the light and reduce the brilliancy of the unshielded filament. In short, it is the function of the inside piece to produce the desired light distribution, while the outside piece diffuses the light and produces an attractive appearance in the unit as a whole. The two pieces are so fitted and clamped together that it is impossible for dirt—even in the most finely divided form to get between them.

The Superlux Refractor is made in two types: The closed type which is always used with Luxsolite Dust-Proof Pendants, and the open type which is used with streethoods. It is very rugged in construction and not subject to excessive breakage.

LIST PRICES

Description	Style No.	Ship. Wt., Lbs., Each	List Price
Holophane Superlux Refractor closed type	352940	9	\$8 60
Holophane Superlux Refractor open type	352939	9	8 60

Order by Style Number

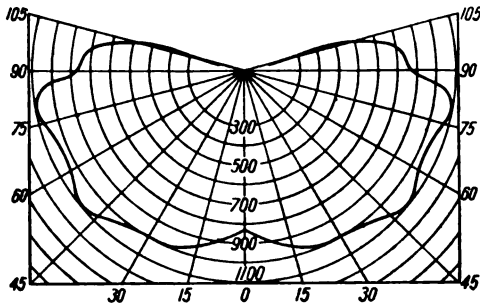
DUST-PROOF LUXSOLITE PENDANTS—Continued

LUXSOLITE RECTILINEAR GLOBES

Experience has shown that glare from a street lighting unit is not only unpleasant but extremely dangerous, blinding alike to pedestrians and vehicle drivers. Glare has sometimes been defined as mis-directed light. A light source of high intrinsic brilliancy, such as an unshielded arc or the filament of a type C lamp unshielded by diffusing glassware invariably produces glare, and the pupil of the human



LUXSOLITE RECTILINEAR GLOBE



DISTRIBUTION CURVE, LUXSOLITE RECTILINEAR GLOBE

The primary purpose of diffusing glassware on a street lighting unit is to convert the piercing glare of high-powered lamps into useful, comfortable, and properly distributed light. It is a well known fact that more unmodified light is required to see objects clearly than is necessary when the glare is eliminated. Consequently, the use of diffusing glassware increases the utility of the light produced by the lamps, the percentage of increase depending upon the efficiency of the glassware itself.

eye becomes so contracted by the intensity of the light source that it cannot, with any degree of precision, discern objects, either stationary or in motion, between it and the point where the lamp is located. In fact for a considerable period after passing beyond the range of such a light source, the eye is still incapable of functioning normally.

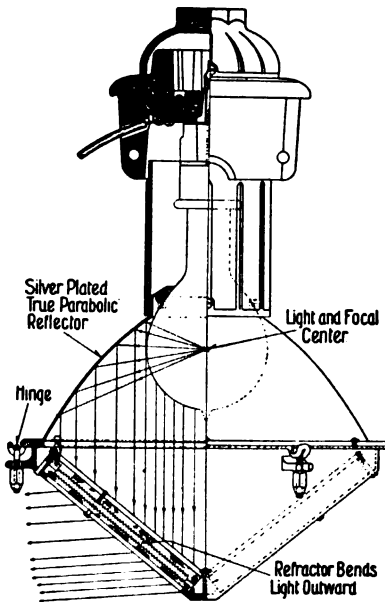
Rectilinear Globes have been designed to diffuse the light both by means of the opalescence of the glassware, and by the arrangement of the flutes. Its sparkling appearance is very attractive and since the absorption of light is very small the efficiency is correspondingly high.

LIST PRICES

Description	Style No.	Ship. Wt., Lbs., Each	List Price
Opalescent Globe	350572	7	\$4 30
Clear globe	350571	7	4 30

Order by Style Number

## HIGHWAY LIGHTING UNIT



SECTIONAL VIEW—HIGHWAY LIGHTING UNIT

The enormous increase in the use of highways for long distance traveling by trucks and automobiles, and the ever-increasing number of accidents at night, bring out the importance of the proper lighting of the more important thoroughfares by some means other than by the headlights of the vehicles themselves. One need not travel far at night on a main highway to be impressed with the vast number of tourists on long distance trips and with the amount of freight that is being transported in heavy-duty trucks. Neither does one travel far before the sight of a road accident, or possibly a narrow escape from one, emphasizes the unmistakable need of proper road lighting.

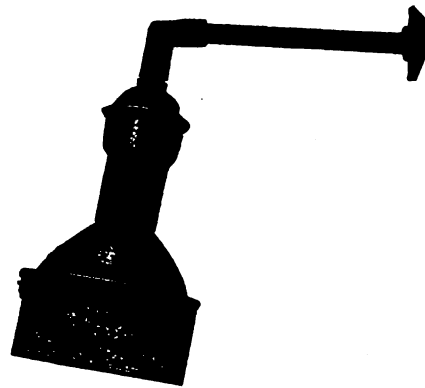
The proper lighting of highways is accomplished by fulfilling two equally important conditions:—1—Providing a clear view of the whole roadway for a considerable distance ahead of the car. 2—Eliminating glare within the range of vision of the driver. The importance of the first condition has led to the extensive use of high-candle-power headlights and adjustable searchlights. These devices are absolutely essential until a more satisfactory system of lighting the roads is provided. As a matter of fact, they would accomplish the desired results, if all traffic were moving in one direction. However, this is seldom, if ever, the case and their use entirely defeats the second essential condition of safe travel at night.

Any bare light source directly within the driver's range of vision, even though at a considerable distance ahead, decreases his acuity of vision to such an extent that the possibility of accident is

materially increased. The driver facing the high candle-power beam of the automobile headlight is rendered practically blind as far as discernment of the road surface and other objects is concerned. The practice of dimming headlights in passing cars is becoming almost universal but it does not entirely relieve the trouble. Ordinarily, the dim headlight is not of sufficient intensity to light the road properly at a time when good light is of supreme importance.

A lighting system that will fulfill the two above mentioned essential conditions must necessarily contain some very special features. Naturally, the most important factor in the system is the lighting unit which must be especially designed for the purpose.

The recently developed highway lighting unit has served to meet these exacting requirements. It consists essentially of a porcelain housing which contains the series socket for a type C lamp, a reflector and a double set of refracting prisms. The unit is arranged for suspension from a series of interchangeable fittings to be fastened to brackets, mast arms, or span wires, as mounting conditions require. The reflector is made of steel highly polished and lacquered on the inside. Its shape is parabolic and so arranged with relation to the refractor prisms that all of the light is thrown in a direction parallel to the roadway. Most of the light is controlled by the upper parabolic reflector which redirects the rays vertically downward



HIGHWAY LIGHTING UNIT

upon the two refracting prisms and thence to the road surface in two directions only.

This unit, placed at the proper height above the road and spaced at proper intervals, will light the roadway at a fairly uniform intensity—a very desirable condition for the driver. Patches of light with darker stretches between, such as obtain under ordinary street lighting conditions, are very tiresome and injurious to the driver's eyes when

HIGHWAY LIGHTING UNIT—Continued

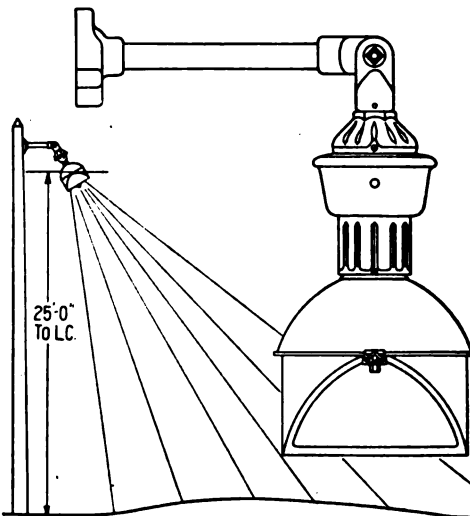
traveling over long stretches of road at a fair rate of speed. The effect upon the eyes is the same as that from a slowly flickering light to which the pupils are continually laboring to adjust themselves.

Another important feature of this unit is the angle of cut-off, which eliminates glare. Practical mounting heights do not permit the unit to be placed above the driver's range of vision so it is very important that his eyes be shielded from the high intensity of the light from the lamp. This is accomplished by positioning the edge of the reflector so that the light in a line parallel to the direction of travel is cut off at a direct angle of 14 degrees below the horizontal—the angle which has been determined by exhaustive tests to be the most practical.

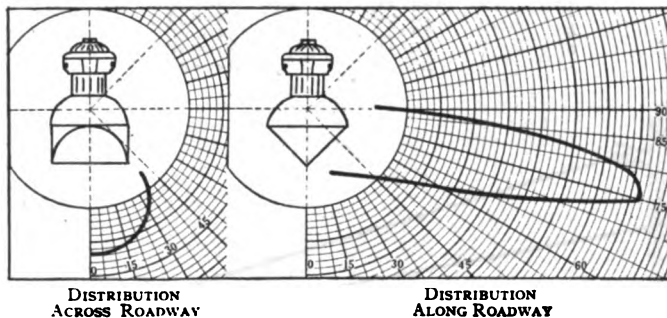
Reflections from polished road surfaces are just as disturbing to the eyes as direct light from the lighting unit itself. This reflector cuts off all light rays which would otherwise be reflected to the driver's eyes from the road surface or from the mirage-light mirror so often appearing upon the road surface during the summer season.

The chief results to be expected from a properly lighted highway are a decided decrease in the number of road accidents and a marked increase in the

comfort and pleasure of night traveling. The prevention of accidents on the highways is of such far reaching importance that every effort to minimize them should be given the utmost consideration.



METHOD OF MOUNTING HIGHWAY LIGHTING UNIT WITH SWIVEL BRACKET



PRICES

List price includes fixture with 1¼-inch canopy and standard film socket.

For 2500, 4000 and 6000 Lumen Straight Series Lamps\*

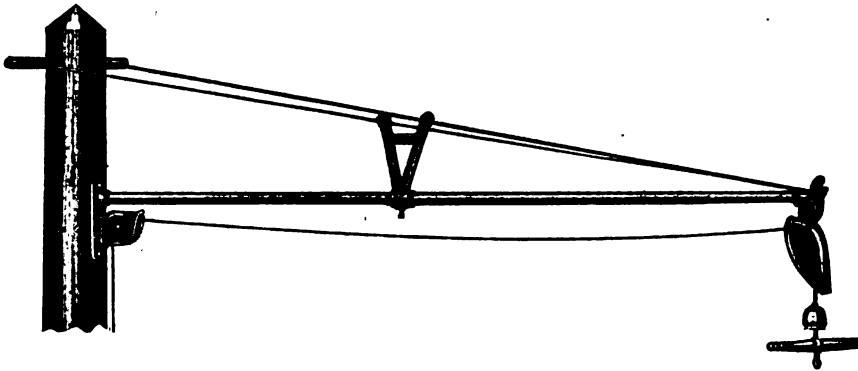
Description	Style No.	Ship. Wt. Lbs., Each	List Price
Complete unit.....	351452	100	\$45 00
Consists of two parts as follows:			
Swivel Bracket.....	353734	25	3 00
Highway Lighting Fixture.....	353368	75	42 00

\*Lamps not included.

Order by Style Number

# CUTTER MAST ARMS

Standard Package Quantity 10

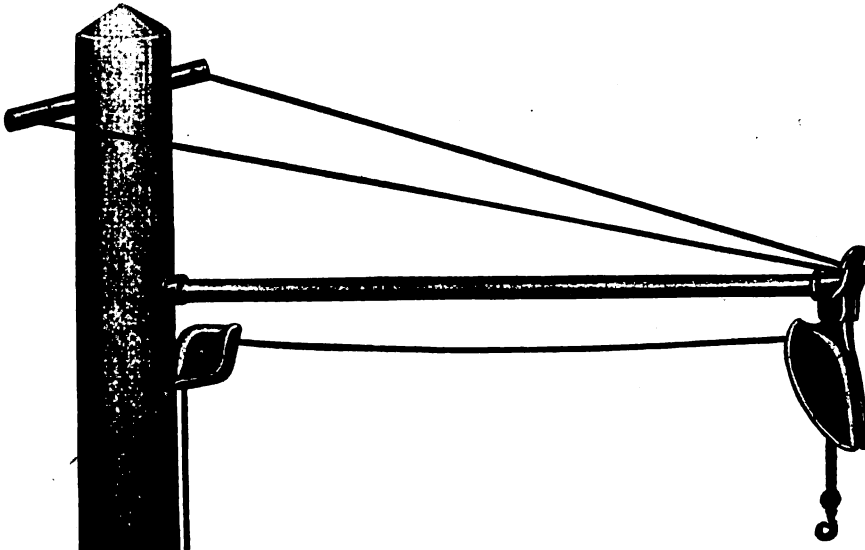


JUNIOR MAST ARM WITH TRIPLE INSULATION ARM

## JUNIOR MAST ARMS

Designed to meet the demand for low priced, yet complete and well braced mast arms. They have pole plates with weatherproof pulleys fitted direct to them and mast arm pulleys for lowering the lamps. Shipped complete with strain rods, strain arm, pipe and pulleys.

Over-Hang Feet	With Clamp Knob Only			With Triple Insulation Arm		
	Style No.	Ship. Wt., Lbs., Each	List Price Each	Style No.	Ship. Wt., Lbs., Each	List Price Each
6	340618	48	\$12 45	340623	51	\$15 05
8	340619	57	13 85	340624	60	16 45
10	340620	60	16 75	340625	63	19 35
12	340621	67	18 15	340626	70	20 75
14	340622	72	20 05	340627	75	22 65



CADET MAST ARM WITH CLAMP KNOB ONLY

## CADET MAST ARMS

Similar to Junior Mast Arms, but without the stiffening triangle.

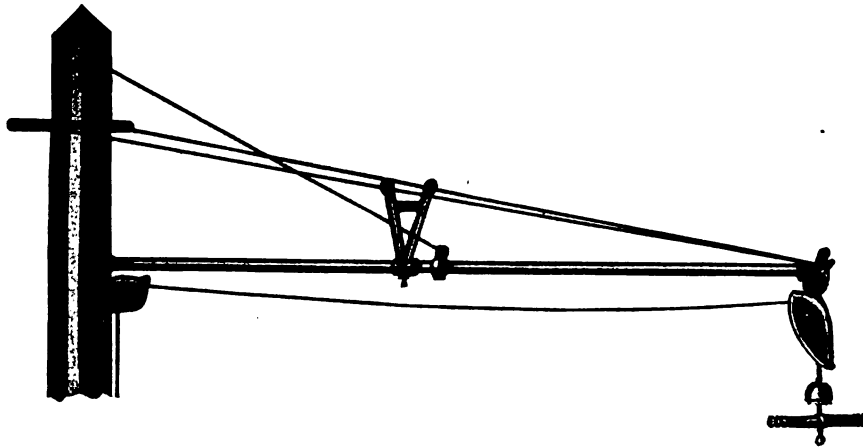
Over-hang Feet	With Clamp Knob Only			With Triple Insulation Arm		
	Style No.	Ship. Wt., Lbs., Each	List Price Each	Style No.	Ship. Wt., Lbs., Each	List Price Each
4	340698	35	\$ 9 75	340701	39	\$12 35
6	340699	40	11 15	340702	44	13 75
8	340700	49	12 55	340703	53	15 15

**Galvanizing:** Any of the above mast arms will be furnished galvanized and painted black, for 20% list additional.

7-337A

CUTTER MAST ARMS—Continued

Standard Package Quantity 10



LONG JUNIOR MAST ARM WITH TRIPLE INSULATION ARM

LONG JUNIOR MAST ARMS

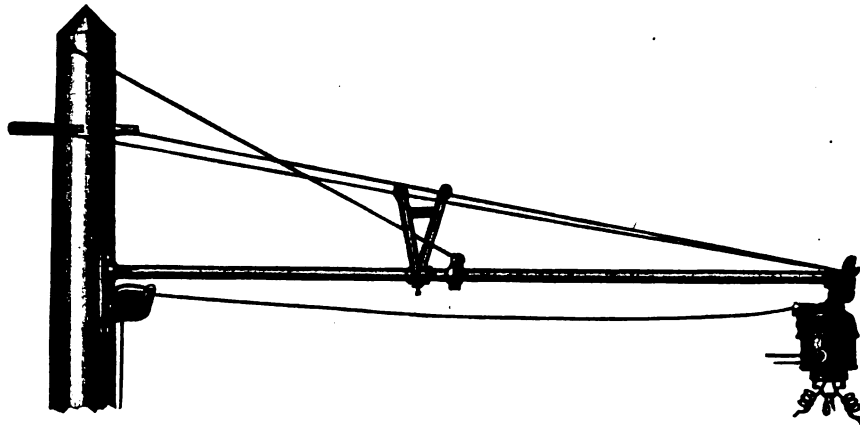
Similar to the Junior, but with double-braced strain arm. An extra support for the center of the pipe is furnished on 14-foot and longer arms.

With Clamp Knob Only

Over-Hang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each
6	340628	52	\$13 95
8	340629	61	15 35
10	340630	64	16 75
12	340631	70	18 15
14	340632	79	22 65
15	340633	85	23 55
16	340634	90	24 25
18	340635	94	26 55
20	340636	100	28 45

With Triple Insulation Arm

Style No.	Ship. Wt. Lbs. Each	List Price Each
340637	55	\$16 55
340638	64	17 95
340639	67	19 35
340640	73	20 75
340641	83	25 25
340642	89	26 15
340643	93	26 85
340644	98	29 15
340645	100	31 05



LONG JUNIOR MAST ARM WITH CUTOUT PULLEY

LONG JUNIOR MAST ARMS

With Series Cutout Pulley

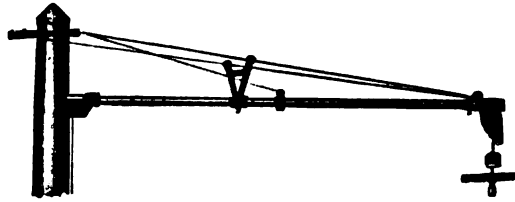
Long Junior Mast Arms as listed above with Standard Series Cutout Pulley in place of lamp-supporting pulley with clamp knob.

Over-hang Feet	Style No.	Ship. Wt., Lbs., Each	List Price Each	Over-hang Feet	Style No.	Ship. Wt., Lbs., Each	List Price Each
6	344373	68	\$24 90	15	344378	101	\$34 50
8	344374	77	26 30	16	344379	106	35 20
10	344375	80	27 70	18	344380	110	37 50
12	344376	86	29 10	20	344381	116	39 40
14	344377	95	33 60				

Galvanizing: Any of the above mast arms will be furnished galvanized and painted black, for 20% list additional.

CUTTER MAST ARMS—Continued

Standard Package Quantity 10



INNER-ROPE MAST ARM WITH TRIPLE INSULATION ARM

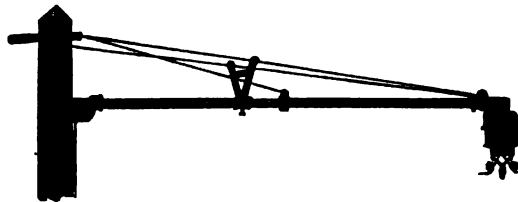
INNER-ROPE MAST ARMS

The pole pulley is built inside the pole plate and the outer supporting pulley fits in a clamp that allows the rope to pass through the pipe. Extra center rod and double-braced strain arm furnished with 14-foot and longer arms.

With Clamp Knob Only

With Triple Insulation Arm

Overhang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each	Style No.	Ship. Wt. Lbs. Each	List Price Each
6	340680	50	\$13 20	340689	53	\$15 80
8	340681	56	14 80	340690	59	17 20
10	340682	66	17 50	340691	69	20 10
12	340683	76	18 90	340692	79	21 50
14	340684	91	23 40	340693	89	26 00
15	340685	95	24 30	340694	99	26 80
16	340686	101	25 00	340695	109	27 60
18	340687	111	27 60	340696	119	30 20
20	340688	121	31 50	340697	129	34 10



INNER-ROPE MAST ARM WITH CUTOUT PULLEY

INNER-ROPE MAST ARMS

With Series Cutout Pulley

Inner-Rope Mast Arms as listed above with Standard Series Cutout Pulley in place of lamp-supporting pulley.

Overhang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each	Overhang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each
6	344395	66	\$24 15	15	344400	111	\$35 25
8	344396	72	25 55	16	344401	117	35 95
10	344397	82	28 45	18	344402	127	38 55
12	344398	92	29 85	20	344403	137	42 45
14	344399	107	34 35				

CORPORAL MAST ARMS

Similar to Inner-Rope Mast Arm, listed above, but without stiffening triangle.

With Clamp Knob Only

With Triple Insulation Arm

Overhang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each	Style No.	Ship. Wt. Lbs. Each	List Price Each
4	340704	39	\$10 50	340707	43	\$13 10
6	340705	44	11 90	340708	48	14 50
8	340706	49	13 30	340709	53	15 90

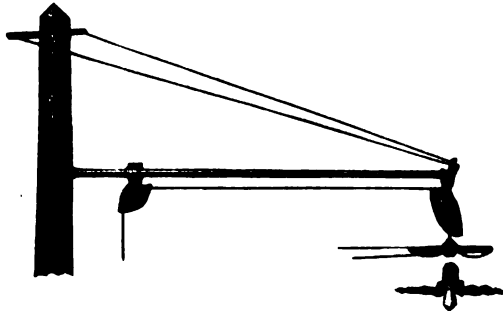
**Galvanizing:** Any of the above mast arms will be furnished galvanized and painted black, for 20% list additional.



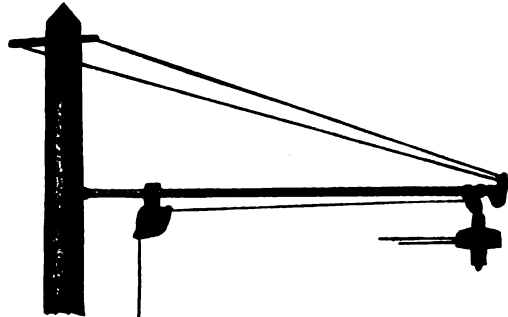
CUTTER MAST ARMS—Continued

STREETHOOD MAST ARMS

Standard Package Quantity 10



MAST ARM FOR MULTIPLE STREETHOOD



MAST ARM WITH AUTOMATIC CUTOUT HANGER

Designed especially for Cutter Multiple Streethoods. Shipped complete, as shown, with 3/4-inch pipe arm, curved pole plate, inner weather-proof pulley, outer Petite pulley with cross arm, strain arm and rods, but without Streethood or rope.

With Automatic Cutout Hanger

Mast Arms as described above, with Automatic Cutout Hanger in place of Petite pulley.

Over-Hang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each
6	340997	30	\$10 80
8	340998	34	12 20
10	340999	38	13 60

Over-Hang Feet	Style No.	Ship. Wt. Lbs. Each	List Price Each
6	344415	45	\$16 05
8	344416	49	17 45
10	344417	53	18 85

ARC POLE TOPS

Has a shadowless plate for wood poles made for wood pins to carry insulators. The wires are run through the curved 3/4-inch pipes, out through porcelain bushings in the arch to the terminals of the lamp. Height from insulator hook to top of pole, 42 inches. Maximum spread of pipes, 27 inches. A pair of insulated reflector clamps, will be furnished for 80 cents list extra.

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
For Wood Poles.....	341595	28	\$9 00
For 2 1/2-inch Bore Pipe.....	341596	34	9 00
For 3-inch Bore Pipe.....	341597	35	9 15
For 4-inch Bore Pipe.....	341598	36	9 45
For 5-inch Bore Pipe.....	341599	37	9 60

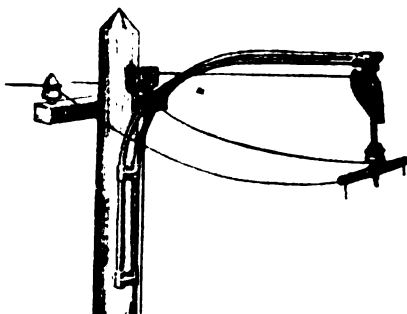


ARC POLE TOP FOR WOOD POLES

PULLEY POLE FIXTURE

A 3-foot fixture complete, with lamp-supporting and pole pulleys, enabling the lamp to be lowered for trimming. A good substitute for a short mast arm.

Furnished with flat plates for attaching to walls or square poles, when so ordered.



PULLEY POLE FIXTURE

	Style No.	Ship. Wt. Lbs. Each	List Price Each
With Clamp Knob Only....	340496	27	\$ 8 15
With Triple Insulation Arm	340497	31	10 75

**Galvanizing:** Any of the above mast arms will be furnished galvanized and painted black, for 20% list additional.

Order by Style Number

7-340A

# CUTTER CUT-OUT PULLEYS

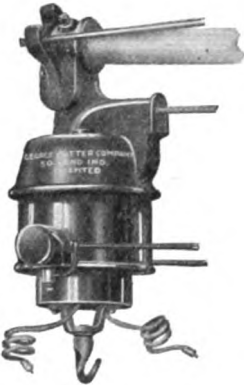
Standard Package Quantity 10

## STANDARD CUT-OUT PULLEYS

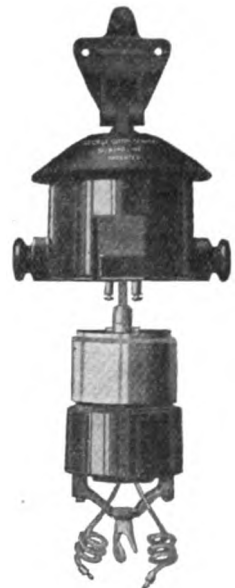
### For Series Circuits



STANDARD CUTOUT PULLEY WITH CABLE CLAMP



STANDARD CUTOUT PULLEY WITH MAST ARM CLAMP



END VIEW OF JUPITER CUT-OUT PULLEY WITH MAST ARM CLAMP

An ingenious, simple and positive device which sustains the lamp and holds it in contact independently of the hoisting rope.

When the lamp is lowered, the series circuit is closed. The circuit wires are run taut to the pulley and are never lowered. The lamp can be lowered straight down without interfering with trolley wires or other obstacles.

Lamps can be cleaned, trimmed, adjusted or replaced on live circuits with perfect safety. The pulley acts as a positive insurance against accidents and protects expensive lamps from damage due to adverse conditions.

No ladders or poles to climb.

It is designed particularly for use on high voltage circuits, either d-c. or a-c.

The contacts are self-cleaning.

There is nothing about the pulley to wear or get out of order.

The switching and supporting features are entirely automatic and certain in operation.

You pull the rope—the pulley does the rest.

Made for rope or chain, as ordered.

Recommended for use with Long Junior and inner-rope mast arms in place of outer mast arm pulleys.

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
Without Suspension Fitting	334995	22	\$13 25
With Cable Clamp	340750	25	13 80
With 1 1/4-inch Mast Arm Clamp	340755	27	14 25
With 1 1/2-inch Mast Arm Clamp	340758	27	14 25
With 1 1/4-inch Inner-Rope Mast Arm Clamp	344382	29	14 85

Use 3/8-inch hoisting rope or 1/4-inch ebony wire rope with these pulleys. Made for use with galvanized chain when so ordered.

## JUPITER CUT-OUT PULLEYS

### For Series Circuits

Built along the same general lines as Standard Cutout Pulleys, but designed for extra heavy duty service. Recommended for d-c. and a-c. series circuits of 2300 volts or higher and for localities where atmospheric conditions demand extra high insulation and heavy current carrying parts. Made for rope or chain as ordered.

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
With Cable Clamp	341143	65	\$22 00
With 1 1/4-inch Mast Arm Clamp	341144	65	22 35
With 1 1/2-inch Mast Arm Clamp	341145	65	22 35
With 1 1/4-inch Inner-Rope Mast Arm Clamp	344404	65	22 95
Upper Section Only, without Suspension Fitting	335007	40	7 60
Lower Section Only	334994	22	13 75

Order by Style Number

## CUTTER MAST ARM PARTS

Standard Package Quantity 10

### Mast Arm Pulleys

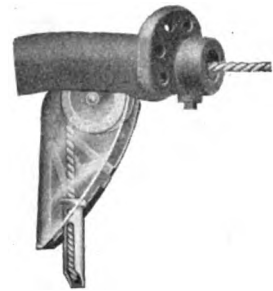
A modification of the lamp-supporting pulley, having an extra strong single-piece clamp, which fits the iron pipe of a mast arm and which also forms the headpiece so that the strain rods can be run direct to it.

#### For 1¼-inch (Bore) Pipe

Description	Style No.	Ship. Wt. Lbs. Each	List Price Each
With clamp knob only . . .	340772	12	\$3 30
With triple insulation arm . . .	340774	16	5 90
With Goliath cross arm . . .	344419	20	7 30
Mast arm clamp only . . . . .	335057	3½	1 00



MAST ARM PULLEY



INNER-ROPE PULLEY

### Inner-Rope Pulleys

A lamp-supporting pulley with a hooded end clamp for use with mast arms in which the rope runs through the pipe.

#### For 1¼-inch (Bore) Pipe

With clamp knob only . . .	340780	14	3 90
With triple insulation arm . . .	340782	18	6 50
With Goliath cross arm . . .	344420	22	7 90
Inner rope mast arm clamp only . . . . .	335094	6½	1 60



MAST ARM CLAMP



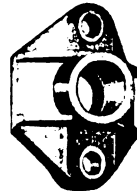
INNER ROPE MAST ARM CLAMP

### Pole Plate without Pulley

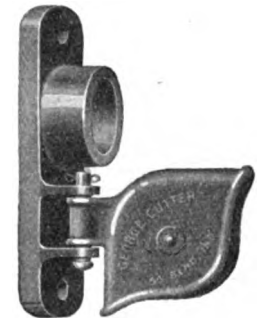
#### For 1¼-inch (Bore) Pipe

Used with mast arms where it is not necessary to lower the lighting unit.

345634	4	1 10
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POLE PLATE WITHOUT PULLEY



JUNIOR POLE PLATE WITH PULLEY

### Junior Pole Plate with Pulley

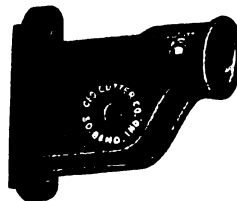
As furnished with the Junior, Long Junior and Cadet Mast Arms. Socket for 1¼-inch pipe is cast on the pole plate. Pulley is similar to the Swivel Pole Pulley.

335099	8	1 85
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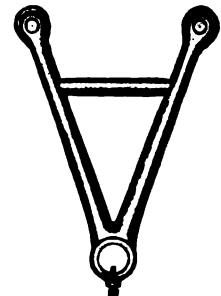
### Pole Housing

The pole plate and pulley casing are made in one piece, with the sheaves placed so the rope can run through the pipe, as with the Inner-Rope and Corporal Mast Arms.

For 1¼-inch (bore) pipe . . .	335123	7	2 15
For 1½-inch (bore) pipe . . .	335158	7	2 15



POLE HOUSING



TRIANGLE

### Triangles

As furnished with Junior, Long Junior and Inner Rope Mast Arms.

For 6, 8, 10 and 12-foot mast arms . . . . .	335106	8	1 30
For 14, 15, 16, 18 and 20-foot mast arms . . . . .	335117	8	1 80

### Strain Arms

As Furnished on Junior and Cadet Mast Arms

Strain arms are made of wrought iron with a cast iron pole plate.

335101	8	1 20
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### Double-Braced Strain Arms

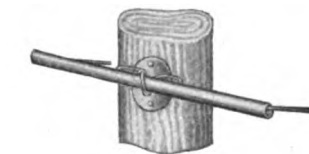
As Furnished on Long Junior Mast Arms

Double-braced strain arms are longer than the regular strain arms and have side braces to prevent rocking in high winds.

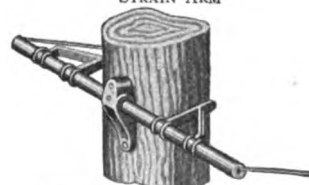
335111	8	2 70
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For galvanizing any of the above, add 50 per cent to list price, which includes final coat of black enamel.

Order by Style Number



STRAIN ARM



DOUBLE-BRACED STRAIN ARM

7-342A

CUTTER MAST ARM PARTS—Continued

Standard Package Quantity 10



CENTER RING



TURNBUCKLE

Style No.	Ship. Wt. Lbs., Each	List Price
	<b>Center Ring</b>	
335078	1 1/4	\$0 45
	<b>Screw Eye</b>	
335065	1/4	45
	<b>Turnbuckle</b>	
335060	1/4	45
	<b>1 1/4-inch Pipe Coupling</b>	
335086	1/4	30

Length	Style No.	Ship. Wt. Lbs., Each	List Price
<b>Strain Rods</b>			
5 ft. 6 in. x 3/8 in.	335134	2 1/4	\$1 10
7 ft. 6 in. x 3/8 in.	335067	3	1 50
8 ft. 6 in. x 3/8 in.	335114	3 1/4	1 70
9 ft. 6 in. x 3/8 in.	334855	3 3/4	1 80
10 ft. 6 in. x 3/8 in.	335083	4	2 10
11 ft. 4 in. x 3/8 in.	334857	4 1/4	2 30
13 ft. 4 in. x 3/8 in.	335072	5 1/4	2 70
15 ft. 4 in. x 3/8 in.	335087	6	3 10
16 ft. 5 in. x 3/8 in.	335115	6 1/4	3 30
17 ft. 4 in. x 3/8 in.	335118	6 3/4	3 50

Length	Style No.	Ship. Wt. Lbs., Each	List Price
<b>Mast Arm Pipe</b>			
6 ft. x 1/2 in.	334849	5 1/2	1 80
8 ft. x 1/2 in.	334848	7 1/4	2 40
10 ft. x 1/2 in.	334856	9	3 00
3 ft. 6 in. x 1 1/4 in.	335136	4 1/4	1 05
4 ft. x 1 1/4 in.	335133	5 1/4	1 20
5 ft. 6 in. x 1 1/4 in.	335124	7 1/4	1 65
6 ft. x 1 1/4 in.	335102	7 3/4	1 80
7 ft. 6 in. x 1 1/4 in.	335126	9 3/4	2 25
8 ft. x 1 1/4 in.	335103	11	2 40
8 ft. x 1 1/4 in. (thread)	335132	11	2 40
9 ft. 6 in. x 1 1/4 in.	335127	12 1/4	2 85
9 ft. 6 in. x 1 1/4 in. (thread)	335131	12 1/4	2 85
10 ft. x 1 1/4 in.	335105	13	3 00
10 ft. x 1 1/4 in. (thread)	335109	13	3 00
11 ft. 6 in. x 1 1/4 in.	335063	14 1/4	3 45
12 ft. x 1 1/4 in.	335107	15 1/2	3 60
13 ft. 6 in. x 1 1/4 in.	335128	17 1/4	4 05
14 ft. x 1 1/4 in.	335108	18	4 20
14 ft. 6 in. x 1 1/4 in.	335129	18 1/4	4 35
15 ft. 6 in. x 1 1/4 in.	335130	19 1/4	4 65
16 ft. x 1 1/4 in.	335119	20 1/4	4 80
18 ft. x 1 1/4 in.	335121	20 3/4	5 40

Order by Style Number

# CUTTER PULLEYS

Standard Package Quantity 10

## Lamp-Supporting Pulleys

Holds the lamp when raised and releases it when about to be lowered. Has a long swivel clamp to fit any size suspension wire or cable and a malleable iron clamp knob to hold the lamp. On raising the lamp, this knob is engaged by the pulley and takes all the strain off the rope. Another pull at the rope guides the knob out so that the lamp can be readily lowered. The action is entirely automatic. The clamp knob clamps any size rope up to 1/2-inch.

Description	Style No.	Wt. Lbs.	List Price Each
With clamp knob only.....	340768	11	\$2 95
With triple insulation arm..	340770	15	5 55
With Goliath cross arm.....	344418	19	6 95
Cable clamp only.....	334787	2	65
Pulley only.....	335091	6	1 50

## Clamp Knobs

With hook only.....	334989	2	80
With triple insulation arm..	340789	6	3 40
With Goliath cross arm....	344421	10	4 80

## Ceiling Pulleys

A form of the lamp-supporting pulley, with a plate for use on bridges or under beams in shops or yards.

With clamp knob only.....	340795	12	3 35
With triple insulation arm..	340796	16	5 95
With Goliath cross arm.....	344422	20	7 35

## Swivel Pole Pulleys

A weatherproof pole pulley, swiveled so that it can swing sideways and keep in line with the hoisting rope. Has a strong malleable iron pole plate.

Swivel Pole Pulley.....	334987	4	1 35
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## Jumbo Pole Pulleys

Similar to the above, but larger, to take 3/4-inch rope.

Jumbo Pole Pulley.....	335168	5 1/2	1 75
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## Interchangeable Pulleys

A weatherproof pulley with a universal clamp made of malleable iron, which will grip any standard size of suspension wire or cable. By taking out the two bolts the clamp can be opened out so as to form a wall plate, which fits the curved surface of a pole and which is easily fastened in place by lag screws. When so used it makes a swiveled pole pulley similar in action to the Cutter Swivel Pole Pulley.

Interchangeable Pulley.....	335170	6	1 60
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## Jumbo Changeable Pulleys

Similar to the interchangeable pulley, but larger, to take 3/4-inch rope.

Jumbo Changeable Pulley..	335171	5 1/2	2 00
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## Midget Changeable Pulley

Similar to the interchangeable pulley, but smaller, to support Multiple Streethoods.

Midget Changeable Pulley..	334910	3	1 40
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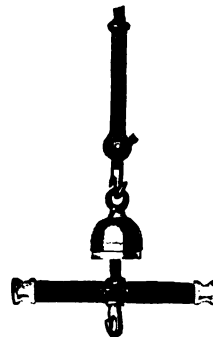
For galvanizing any of the above including final coat of black enamel add 50 per cent to list price.



LAMP-SUPPORTING PULLEY WITH CLAMP KNOB



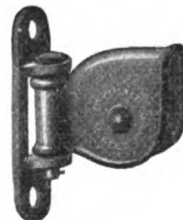
CLAMP KNOB



CLAMP KNOB WITH TRIPLE INSULATION ARM



CEILING PULLEY



SWIVEL POLE PULLEY



INTERCHANGEABLE PULLEY

Order by Style Number

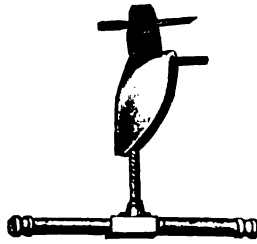
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CUTTER PULLEYS—Continued

Standard Package Quantity 10



SLEEVE PULLEY



PETITE PULLEY WITH CROSS ARM



MEDIUM PULLEY WITH CLAMP



PLAIN END PULLEY



OUTRIGGER PULLEY

Sleeve Pulleys

A weatherproof pulley with a sleeve clamp to grip iron pipe.

	Style No.	Wt., Lbs.	List Price
For 3/4-inch pipe.....	340798	6	\$1 30
For 1-inch pipe.....	340799	6	1 40
For 1 1/4-inch pipe.....	340800	7	1 50
For 1 1/2-inch pipe.....	340801	7	1 60

Petite Pulley with Cross Arm

Consists of a Petite lamp-supporting pulley for cable suspension, with a movable cross arm. Designed for use with Multiple Streethoods.

340431	6 1/2	3 00
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Outrigger Pulleys

A form of the lamp-supporting pulley, with a clamp to fit the pipe. Furnished with clamp knob.

Description	Style No.	Wt., Lbs.	List Price
For 3/4-inch (bore) pipe...	340791	9	\$2 70
For 1-inch (bore) pipe...	340792	9	2 80
For 1 1/4-inch (bore) pipe...	340793	10	2 90
For 1 1/2-inch (bore) pipe...	340794	10	3 00

Plain End Pulleys

A plain weatherproof pulley with an end clamp to fit mast arm pipe.

For 1 1/4-inch (bore) pipe...	340803	6 1/2	1 90
For 1 1/2-inch (bore) pipe...	340804	6 3/4	1 90

Medium Pulleys

A center suspension pulley with long supporting clamp and weatherproof casing, but with no safety features. Takes any size rope up to 1/2-inch in diameter, and is second only to the lamp-supporting pulley.

Medium Pulley with clamp.	340805	5 1/2	1 55
Pulley only.....	335021	.....	90

For galvanizing any of the above, including final coat of black enamel, add 50 per cent to list price.

Order by Style Number

## CUTTER INSULATORS AND CROSS ARMS

Standard Package Quantity 10

### High Voltage Insulators

High voltage insulators have a double petticoat porcelain bell, which forms a good watershed and gives high insulation even in wet weather. The rivets which fasten the metal cap to the porcelain pass under the elongated head of the bolt which supports the hook. The cap is sealed with insulating material and the extra petticoat gives a large surface insulation, making the device well suited for use on arc circuits exposed to weather, smoke or fumes. All iron parts are electro-galvanized and painted black.

Description	Style No.	Wt. Lbs. Each	List Price
With ring above and sister hook below.....	335189	4	\$1 90
With clamp for wire rope above and ring below....	335185	4	2 15
With clamp for chain above and ring below.....	335187	4	2 15
With clamp for 3/4-inch rope above and ring below....	344423	4	2 15

### Jupiter Insulators

Built on the same lines generally as high voltage insulators, but with a greatly enlarged series of petticoats to give higher surface insulation. Therefore it has the same high breakdown insulation (ample for 12,000-volt circuits) and an extra large surface to reduce the leakage in wet weather. All iron parts are electro-galvanized and painted black.

With ring above and sister hook below.....	335188	6	2 50
With clamp for wire rope above and ring below....	335280	6	2 75
With clamp for chain above and ring below.....	338993	6	2 75
With clamp for 3/4-inch rope above and ring below....	344430	6	2 75

### Triple Insulation Arms

Triple insulation arms have a high voltage insulator above an enameled wood arm, thus giving a triple insulation between the line wire and the supporting ring.

The arm is coated with a baked enamel, which outwears paint in the weather, and has its ends bound by strong metal ferrules to prevent their splitting. Every part of the whole device is built for fine wear and high insulation, making it a fine insulating arm for all high voltage lamps, and the only low priced one adapted for use with alternating series lamps. It is second only to the Goliath cross-arm.

Galvanized.....	337379	4	2 60
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### Goliath Cross Arms

An insulating cross arm having both the wire supports and the lamp hook insulated from the support by a Jupiter insulator. The cross arm is of iron, fitted with porcelain knobs for supporting the line wires and a sister hook for the lamp.

Galvanized.....	344431	8	4 00
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### Grip Arms

Consists of the plain arm with a "U" bolt for clamping same to 1 1/4-inch (bore) iron piping as used on mast arms, outriggers and brackets.

"U"-bolt, galvanized.....	335205	1 1/4	1 25
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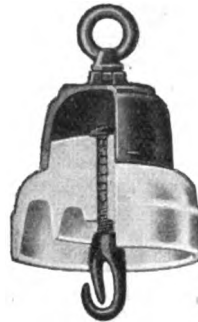
Order by Style Number



No. 335189



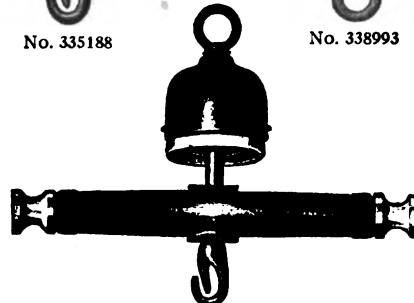
No. 335185



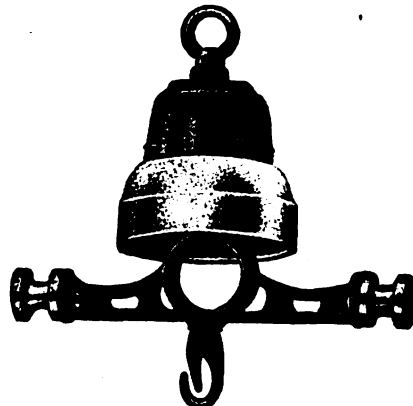
No. 335188



No. 338993



TRIPLE INSULATION ARM



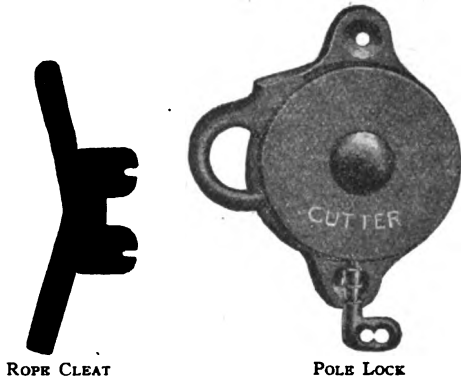
GOLIATH CROSS ARM



GRIP ARM

## CUTTER POLE LINE MATERIAL

Standard Package Quantity 10



ROPE CLEAT

POLE LOCK

### Pole Locks

Has the keyhole at the bottom and not at the top (where the rain and sleet would drive into it.) The double catch makes it non-pickable, the back fits either a wall or pole, and the casting makes it weatherproof. One key free with every ten locks.

Description	Style No.	Wt. Lbs. Each	List Price Each
*Galvanized.....	335211	1 1/4	\$1 25
Extra key.....	335212	1 oz.	15

### Rope Cleats

Has the edges rounded so as not to cut the rope.

*Galvanized.....	340811	1	65
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### Rope Clamps

Made of malleable iron, will readily clamp any size rope up to 3/8-inch, enabling the end of the hoisting rope to be locked at the pole.

*Galvanized.....	335216	1/4	45
Same as above for 1/4-inch ropes.			
*Galvanized.....	335218	1/4	90



ROPE CLAMP

CHAIN CLAMP

### Chain Clamps

A neat, secure fastening, enabling the end of the hoisting chain to be locked to the pole. Made for No. 1 or No. 3 Oneida Chain.

*Galvanized.....	335220	1/4	45
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### Combination Windlasses

These are self-locking safety windlasses which can be used either as plain or geared windlasses at the option of the trimmer. Can be used as plain windlass to lower the lamp quickly, and then as a geared windlass to raise the lamp. These windlasses are perfectly safe for lamps up to 80 pounds, the whole device being as fool-proof as possible.

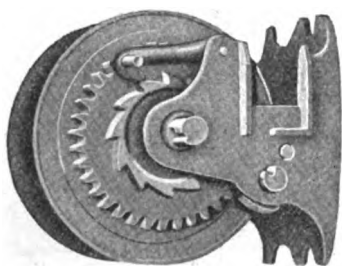
The pinion handle is detachable so that it can be used with any number of windlasses.

The drum will hold 60 feet of 1/4-inch Ebony Wire Rope or 40 feet of 3/8-inch Banner Core Rope.

Price of windlass does not include handle.

For wood poles.....	335180	22	7 00
For wall mounting.....	335182	24	7 00
Pinion handle.....	335181	4	4 00

\*Includes final coat of black enamel.



COMBINATION WINDLASS

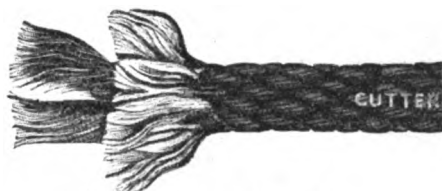
Order by Style Number



CUTTER POLE LINE MATERIAL—Continued

Standard Package Quantity 10

**Weatherproof Lamp Rope**



WEATHERPROOF LAMP ROPE



EBONY WIRE ROPE

A fine braided cotton rope with a weatherproof finish, which keeps out the rain and makes it extra durable. We recommend the  $\frac{3}{8}$  and  $\frac{1}{2}$ -inch sizes for hoisting arc lamps, the  $\frac{1}{4}$  and  $\frac{5}{16}$ -inch for use with the swinging hoods and the  $\frac{3}{8}$ -inch for the Always Level Streethoods.

Style No.	Size Inches	Approx. Wt. Lbs. per 100-ft.	List Price per Lb.
338019	$\frac{3}{8}$	2	\$2 60
338020	$\frac{1}{4}$	2 $\frac{1}{2}$	2 60
338021	$\frac{5}{16}$	3 $\frac{1}{8}$	2 60
338022	$\frac{3}{8}$	5	2 60
338023	$\frac{1}{2}$	8	2 60

**Ebony Wire Rope**

A  $\frac{1}{4}$ -inch wire rope of six flexible strands (each with soft center) around a flexible (black) center. The only wire rope pliable enough to work freely with standard types of pulleys.

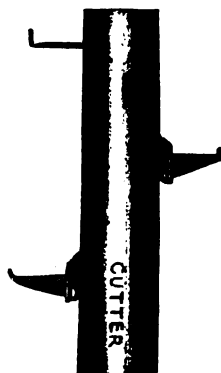
Style No.	No. of Feet in Std. Pkg.	Approx. Wt. Lbs. per 100 ft.	List Price per ft.
335226	1000	5	\$0 08

**Standard Feeder Arms, Cast Iron**

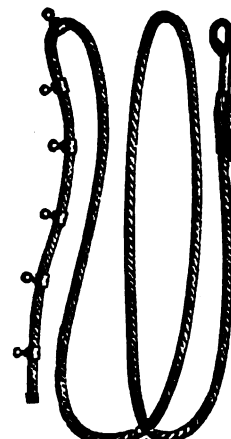
Description	Style No.	Ship. Wt. Each	List Price Each
<b>Two-wire</b>			
For 2 $\frac{1}{2}$ -inch (bore) pipe.....	344432	22	\$5 25
For 3-inch (bore) pipe.....	336194	23	5 50
<b>Four-wire</b>			
For 2 $\frac{1}{2}$ -inch (bore) pipe.....	344433	27	6 25
For 3-inch (bore) pipe.....	336198	28	6 50

Order by Style Number

**Removable Pole Steps**



REMOVABLE POLE STEP



TRIMMER'S ROPE

Removable pole steps are much more easily carried than a ladder. A pair of them weighs less than 14 ounces, and can be slipped into the pocket. The sockets for them are hooded over so as to be sleet-proof.

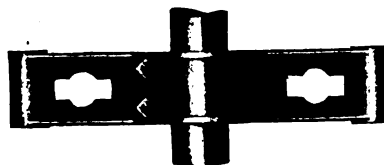
Description	Style No.	Wt. Lbs.	List Price
*Pole step, galvanized.....	335230	$\frac{1}{2}$	\$0 45
*Socket, galvanized.....	335231	$\frac{1}{2}$	30

\*Includes final coat of black enamel.

**Trimmer's Rope**

A 30-foot rope, with a snap hook at one end and six rings clamped at any desired interval, near the other end so as to accommodate lamps hung at varying heights.

Style No.	Std. Pkg.	Wt. Lbs.	List Price
335227	10	4	\$5 50



STYLE No. 336198



## ORNAMENTAL POSTS AND BRACKETS



Ornamental street lighting is the paramount attainment in city beautification. It expresses art and economy, progress and morality, safety and comfort as the prime issues of a city or town government. An installation of ornamental standards accomplishes an aesthetic purpose as well as a practical one. It encourages civic betterment and stimulates business activity. Streets are kept cleaner and building fronts are made more attractive because of their pleasing appearance by day. By night, adequate illumination is afforded by clusters of soft lights or single units of high candlepower lamps enclosed in globes of diffusing glass.

The selection of artistic standards is the most important consideration in the plan of an ornamental lighting system. The posts should harmonize with their surroundings, should be sturdy in construction and easy to install. Cutter Posts are made by pioneers in the field of outdoor electric lighting. Over a quarter of a century has been devoted to the design and manufacture of electrical lighting fixtures. Cutter Posts are artistic and original in design. They are made of best quality grey iron, the recognized standard material for ornamental posts. They are made from metal patterns, thus insuring clean castings with ornaments true to design. There are many designs to select from, so that one can be found exactly suited to any individual requirement.

Until recently, the single-light standard has been used almost exclusively in the residential portions

of cities, for park and boulevard lighting and for entrances to private grounds and public buildings. The development of the high efficiency incandescent units of high candlepower has made it possible to install single-light posts in business districts, so spaced that the illumination is adequate for all purposes, and the cost of installation and maintenance reduced to a minimum.

These new lamps are more efficient in the 15 or 20-ampere class. As it is not practical usually to supply power to the lamps at these values, compensators are mounted in the tops of the posts to take power from a 6.6 or 7.5-ampere line and deliver it to the lamps at 15 or 20 amperes.

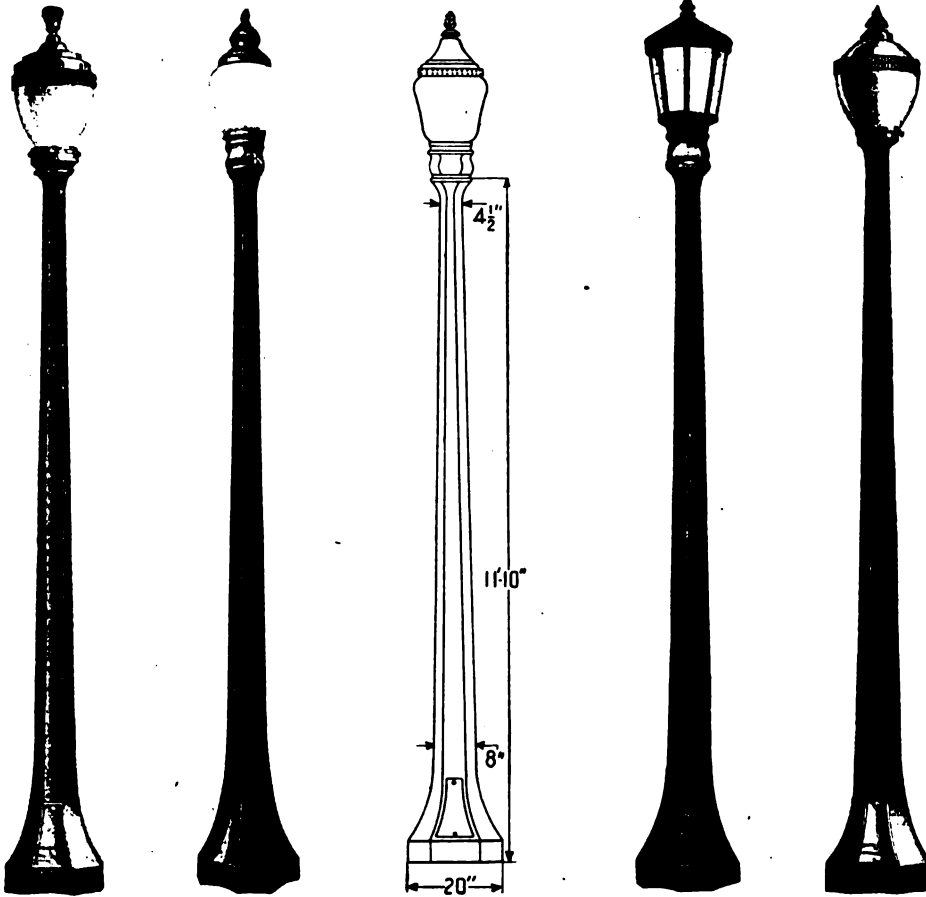
Operating these lamps on a series circuit of high potential necessitates the use of a pothead in the base of the post. This is described on a following page. This device also makes clusters of series lamps economical and safe, whereas in the past, multiple lamps have been used generally for cluster lighting.

The popular designs of Cutter Posts are listed on the following pages. Post parts are listed separately to facilitate selecting special combinations other than those listed complete. Special designs and drawings, showing many pleasing combinations, will be submitted upon request. Our Illuminating Engineering Bureau plans complete systems and furnishes expert advice upon request.

Unless otherwise ordered, Posts, Newels and Brackets will be supplied in black finish.

# CUTTER SINGLE-LIGHT POSTS

## Arcadian Posts



STYLE No. 353508      STYLE No. 343618      STYLE No. 353477      STYLE No. 353498      STYLE No. 353483

Complete posts are made up in various combinations of three principal parts: column, casing and top. Arcadian posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Lt. Ctr.		Complete Post	STYLE NUMBERS			Ht. to Lt. Ctr.		
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.	
	<b>With Sol-Lux Sr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
343617	336081	336208	351270	12	10	353499	336081		351322	12	10	
343618	336081	336152	351270	13	4	353500	336081	350862	351322	13	4	
343619	336081	336208	351271	12	10	353501	336081		351323	12	10	
343620	336081	336152	351271	13	4	353502	336081	350862	351323	13	4	
343621	336081	336152	351272	13	4	353503	336081	350862	351325	13	4	
343622	336081	336152	351273	13	4	353504	336081	350862	351326	13	4	
343623	336081	336152	351274	13	4	353505	336081	350862	351327	13	4	
	<b>With Sol-Lux Sr. Top, Glass Canopy</b>						353506	336081	350862	351328	13	4
353476	336081	336208	351276	12	10	353507	336081	350862	351329	13	4	
353477	336081	336152	351276	13	4		<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>					
353478	336081	336208	351278	12	10	353508	336081		351335	12	10	
353479	336081	336152	351278	13	4	353509	336081	350862	351335	13	4	
353480	336081	336152	351279	13	4	353510	336081		351337	12	10	
353481	336081	336152	351280	13	4	353511	336081	350862	351337	13	4	
353482	336081	336152	351281	13	4	353512	336081	350862	351339	13	4	
	<b>With Meridian Sr. Top</b>						353513	336081	350862	351340	13	4
353483	336081	336208	351296	12	10	353514	336081	350862	351341	13	4	
353484	336081	336152	351296	13	4		<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>					
353485	336081	336208	351298	12	10	353515	336081		351342	12	10	
353486	336081	336152	351298	13	4	353516	336081	350862	351342	13	4	
353487	336081	336152	351299	13	4	353517	336081		351344	12	10	
353488	336081	336152	351300	13	4	353518	336081	350862	351344	13	4	
353489	336081	336152	351301	13	4	353519	336081	350862	351346	13	4	
	<b>With Octagonal Sr. Reflectolux Top</b>						353520	336081	350862	351347	13	4
353490	336081		351309	13	1	353521	336081	350862	351348	13	4	
353491	336081	350862	351309	13	7		<b>With Pagoda Top</b>					
353492	336081		351311	13	1	353522	336081		351365	12	9 1/4	
353493	336081		351311	13	7	353523	336081	350862	351365	13	3 1/4	
353494	336081	350862	351313	13	7	353524	336081		351367	12	9 1/4	
353495	336081	350862	351314	13	7	353525	336081	350862	351367	13	3 1/4	
353496	336081	350862	351315	13	7	353526	336081	350862	351384	13	3 1/4	
	<b>With Octagonal Jr. Reflectolux Top</b>						353527	336081	350862	351385	13	3 1/4
353497	336081		351320	12	10	353528	336081	350862	351386	13	3 1/4	
353498	336081	350862	351320	13	4							

## CUTTER SINGLE-LIGHT POSTS

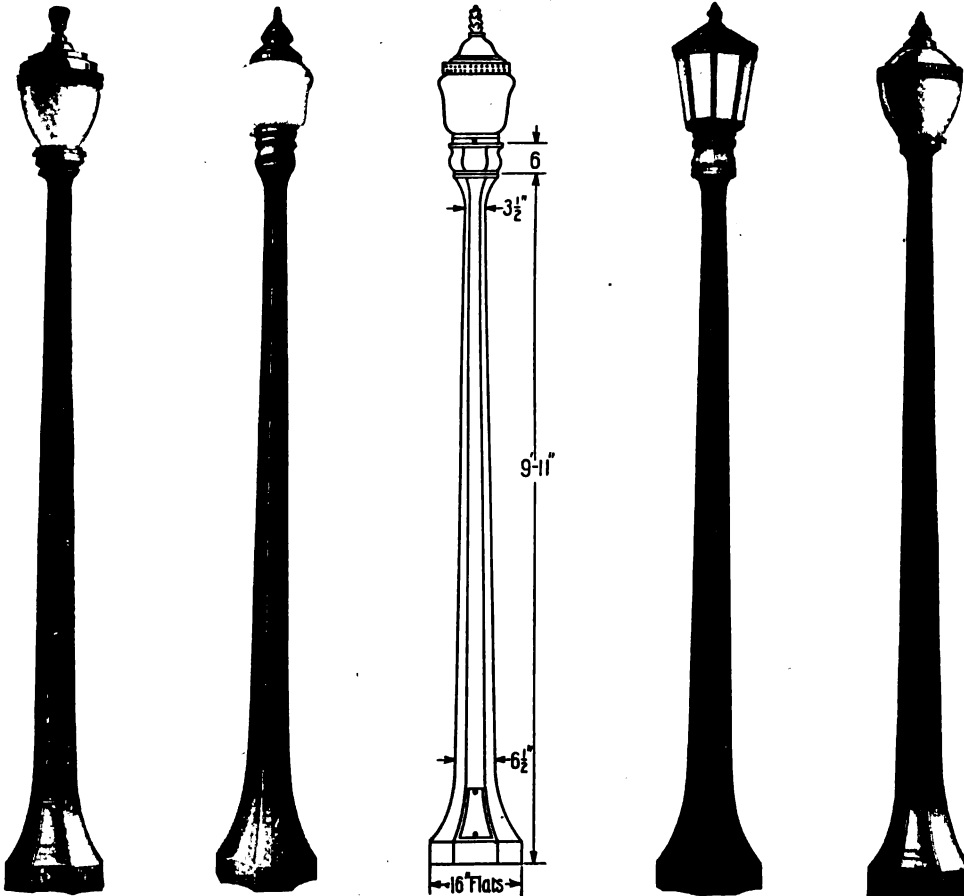
## Arcadian Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket	343617	434	\$104 00
With Arcadian Casing and Regent Film Socket	343618	468	110 00
With Mogul Multiple Socket	343619	434	103 00
With Arcadian Casing and Mogul Multiple Socket	343620	468	109 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	343621	479	118 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	343622	480	119 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	343623	484	123 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket	353476	436	106 00
With Arcadian Casing and Regent Film Socket	353477	470	112 00
With Mogul Multiple Socket	353478	436	105 00
With Arcadian Casing and Mogul Multiple Socket	353479	470	111 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353480	481	120 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353481	482	121 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353482	486	125 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket	353483	438	105 00
With Arcadian Casing and Regent Film Socket	353484	472	111 00
With Mogul Multiple Socket	353485	438	104 00
With Arcadian Casing and Mogul Multiple Socket	353486	472	110 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353487	483	119 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353488	484	120 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353489	488	124 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket	353490	526	163 00
With Arcadian Casing and Regent Film Socket	353491	560	169 00
With Mogul Multiple Socket	353492	526	162 00
With Arcadian Casing and Mogul Multiple Socket	353493	560	168 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353494	571	177 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353495	572	178 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353496	576	182 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	353497	461	118 00
With Arcadian Casing and Regent Film Socket	353498	495	124 00
With Medium Multiple Socket	353499	461	116 90
With Arcadian Casing and Medium Multiple Socket	353500	495	122 90
With Mogul Multiple Socket	353501	461	117 00
With Arcadian Casing and Mogul Multiple Socket	353502	495	123 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353503	498	134 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353504	501	135 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353505	506	132 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353506	507	133 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353507	511	137 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	353508	461	113 00
With Arcadian Casing and Regent Film Socket	353509	495	119 00
With Mogul Multiple Socket	353510	461	112 00
With Arcadian Casing and Mogul Multiple Socket	353511	495	118 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353512	506	132 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353513	507	133 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353514	511	137 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	353515	464	118 00
With Arcadian Casing and Regent Film Socket	353516	498	124 00
With Mogul Multiple Socket	353517	464	117 00
With Arcadian Casing and Mogul Multiple Socket	353518	498	123 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353519	509	132 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353520	510	133 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353521	514	137 00
<b>With Pagoda Top</b>			
With Regent Film Socket	353522	536	145 00
With Arcadian Casing and Regent Film Socket	353523	570	151 00
With Mogul Multiple Socket	353524	536	144 00
With Arcadian Casing and Mogul Multiple Socket	353525	570	150 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353526	581	159 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353527	582	160 50
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353528	586	164 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Arcadian Junior Posts



STYLE No. 353558

STYLE No. 343625

STYLE No. 353530

STYLE No. 353548

STYLE No. 353538

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Arcadian Junior Posts as listed on the opposite page are made up in the following combinations.

STYLE NUMBERS				Ht. to Light Center		STYLE NUMBERS				Ht. to Light Center	
Complete Post	Column	Casing	Top	Ft.	In.	Complete Post	Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Jr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
343624	336093	336208	351282	10	9	353548	336093	350662	351320	11	4
343625	336093	336152	351282	11	3	353549	336093	.....	351322	10	10
343626	336093	336208	351284	10	9	353550	336093	350662	351322	11	4
343627	336093	336152	351284	11	3	353551	336093	.....	351323	10	10
343628	336093	336208	351285	10	9	353552	336093	350662	351323	11	4
343629	336093	336152	351285	11	3	353553	336093	350662	351325	11	4
343630	336093	336152	351286	11	3	353554	336093	350662	351326	11	4
343631	336093	336152	351287	11	3	353555	336093	350662	351327	11	4
343632	336093	336152	351288	11	3	353556	336093	350662	351328	11	4
353529	336093	336208	351289	10	9	353557	336093	350662	351329	11	4
353530	336093	336152	351289	11	3	<b>With Egyptian Jr. Reflectolux Top, Metal Canopy</b>					
353531	336093	336208	351291	10	9	353558	336093	.....	351349	10	10
353532	336093	336152	351291	11	3	353559	336093	350662	351349	11	4
353533	336093	336208	351292	10	9	353560	336093	.....	351351	10	10
353534	336093	336152	351292	11	3	353561	336093	350662	351351	11	4
353535	336093	336152	351293	11	3	353562	336093	.....	351352	10	10
353536	336093	336152	351294	11	3	353563	336093	350662	351352	11	4
353537	336093	336152	351295	11	3	353564	336093	350662	351354	11	4
<b>With Meridian Jr. Top</b>						353565	336093	350662	351355	11	4
353538	336093	336208	351302	10	9	353566	336093	350662	351356	11	4
353539	336093	336152	351302	11	3	<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
353540	336093	336208	351304	10	9	353567	336093	.....	351357	10	10
353541	336093	336152	351304	11	3	353568	336093	350662	351357	11	4
353542	336093	336208	351305	10	9	353569	336093	.....	351359	10	10
353543	336093	336152	351305	11	3	353570	336093	350662	351359	11	4
353544	336093	336152	351306	11	3	353571	336093	.....	351360	10	10
353545	336093	336152	351307	11	3	353572	336093	350662	351360	11	4
353546	336093	336152	351308	11	3	353573	336093	350662	351362	11	4
<b>With Octagonal Jr. Reflectolux Top</b>						353574	336093	350662	351363	11	4
353547	336093	.....	351320	10	10	353575	336093	350662	351364	11	4

## CUTTER SINGLE-LIGHT POSTS—Continued

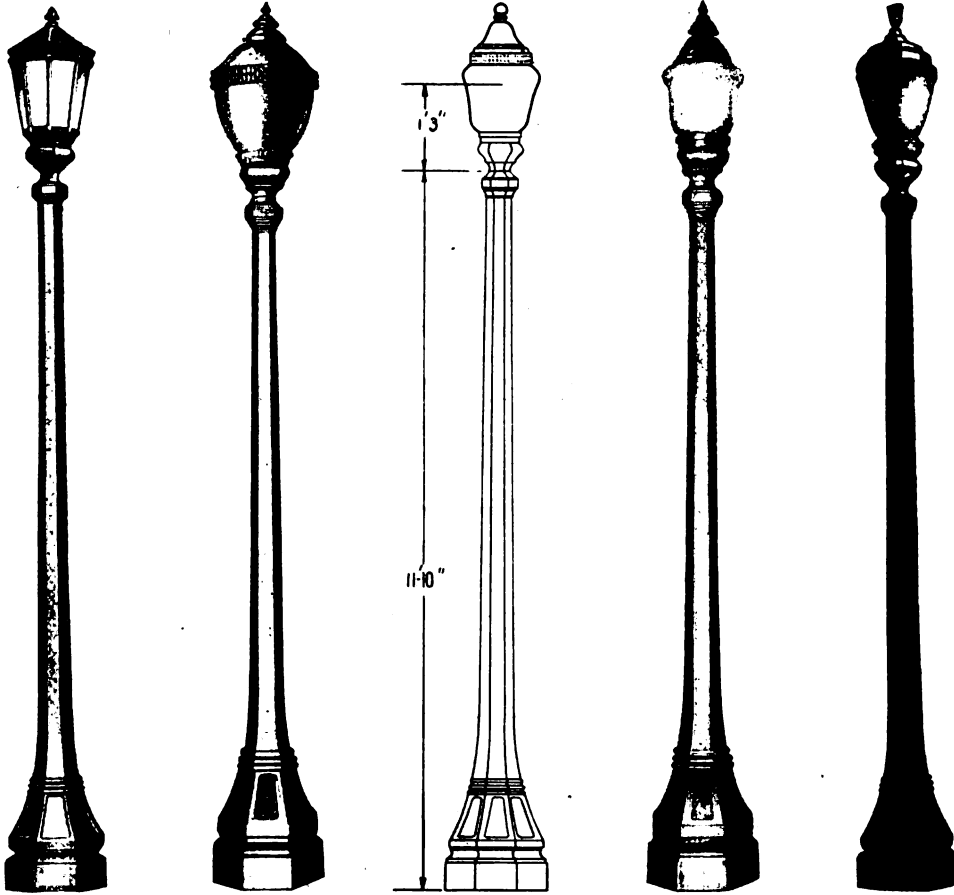
## Arcadian Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	343824	289	84 00
With Arcadian Casing and Regent Film Socket	343825	323	90 00
With Medium Multiple Socket	343826	289	82 90
With Arcadian Casing and Medium Multiple Socket	343827	323	88 90
With Mogul Multiple Socket	343828	289	83 00
With Arcadian Casing and Mogul Multiple Socket	343829	323	89 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	343830	326	100 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	343831	329	101 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	343832	334	98 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	353529	291	86 00
With Arcadian Casing and Regent Film Socket	353530	325	92 00
With Medium Multiple Socket	353531	291	84 90
With Arcadian Casing and Medium Multiple Socket	353532	325	90 90
With Mogul Multiple Socket	353533	291	85 00
With Arcadian Casing and Mogul Multiple Socket	353534	325	91 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353535	328	102 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353536	331	103 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353537	336	100 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	353538	289	85 00
With Arcadian Casing and Regent Film Socket	353539	323	91 00
With Medium Multiple Socket	353540	289	83 90
With Arcadian Casing and Medium Multiple Socket	353541	323	89 90
With Mogul Multiple Socket	353542	289	84 00
With Arcadian Casing and Mogul Multiple Socket	353543	323	90 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353544	326	101 00
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353545	329	102 00
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353546	334	99 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	353547	319	102 80
With Arcadian Casing and Regent Film Socket	353548	353	108 80
With Medium Multiple Socket	353549	319	101 50
With Arcadian Casing and Medium Multiple Socket	353550	353	107 50
With Mogul Multiple Socket	353551	319	101 80
With Arcadian Casing and Mogul Multiple Socket	353552	353	107 80
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353553	356	118 80
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353554	359	119 80
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353555	364	118 80
With Arcadian Casing, Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353556	365	118 10
With Arcadian Casing, Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353557	369	121 80
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	353558	319	95 10
With Arcadian Casing and Regent Film Socket	353559	353	101 10
With Medium Multiple Socket	353560	319	94 00
With Arcadian Casing and Medium Multiple Socket	353561	353	100 00
With Mogul Multiple Socket	353562	319	94 10
With Arcadian Casing and Mogul Multiple Socket	353563	353	100 10
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353564	356	111 10
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353565	359	112 10
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353566	364	109 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	353567	322	100 10
With Arcadian Casing and Regent Film Socket	353568	356	106 10
With Medium Multiple Socket	353569	322	99 00
With Arcadian Casing and Medium Multiple Socket	353570	356	105 00
With Mogul Multiple Socket	353571	322	99 10
With Arcadian Casing and Mogul Multiple Socket	353572	356	105 10
With Arcadian Casing, Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353573	359	116 10
With Arcadian Casing, Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353574	362	117 10
With Arcadian Casing, Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353575	367	119 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Edgewater Posts



STYLE No. 353606

STYLE No. 353583

STYLE No. 353593

STYLE No. 353588

STYLE No. 353598

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Edgewater Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.	Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.
	Column	Casing	Top			Column	Casing	Top	
<b>With Sol-Lux Sr. Top, Metal Canopy</b>					<b>With Octagonal Jr. Reflectolux Top—Continued</b>				
353586	350379	351383	351270	13 2	353603	350379	353387	351323	13 2
353587	350379	351383	351271	13 2	353604	350379	351382	351325	13 2 1/4
353588	350379	336540	351272	13 2 1/2	353605	350379	351382	351326	13 2 1/4
353589	350379	336540	351273	13 2 1/2	353606	350379	351382	351327	13 2 1/4
353590	350379	336540	351274	13 2 1/2	353607	350379	351382	351328	13 2 1/4
<b>With Sol-Lux Sr. Top, Glass Canopy</b>					<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>				
353591	350379	351383	351276	13 2	353596	350379	353387	351335	13 2
353592	350379	351383	351278	13 2	353597	350379	353387	351337	13 2
353593	350379	336540	351279	13 2 1/2	353598	350379	351382	351339	13 2 1/4
353594	350379	336540	351280	13 2 1/2	353599	350379	351382	351340	13 2 1/2
353595	350379	336540	351281	13 2 1/2	353600	350379	351382	351341	13 2 1/2
<b>With Meridian Sr. Top</b>					<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>				
353581	350379	351383	351296	13 2	353609	350379	353387	351342	13 2
353582	350379	351383	351298	13 2	353610	350379	353387	351344	13 2
353583	350379	336540	351299	13 2 1/2	353611	350379	351382	351346	13 2 1/4
353584	350379	336540	351300	13 2 1/2	353612	350379	351382	351347	13 2 1/2
353585	350379	336540	351301	13 2 1/2	353613	350379	351382	351348	13 2 1/2
<b>With Octagonal Sr. Reflectolux Top</b>					<b>With Pagoda Top</b>				
353576	350379	353387	351309	13 5	353614	350379	353387	351365	13 1 1/4
353577	350379	353387	351311	13 5	353615	350379	353387	351367	13 1 1/2
353578	350379	351382	351313	13 5 1/2	353616	350379	351382	351384	13 2
353579	350379	351382	351314	13 5 1/2	353617	350379	351382	351385	13 2
353580	350379	351382	351315	13 5 1/2	353618	350379	351382	351386	13 2
<b>With Octagonal Jr. Reflectolux Top</b>									
353601	350379	353387	351320	13 2					
353602	350379	353387	351322	13 2					

Order by Style Number



## CUTTER SINGLE-LIGHT POSTS—Continued

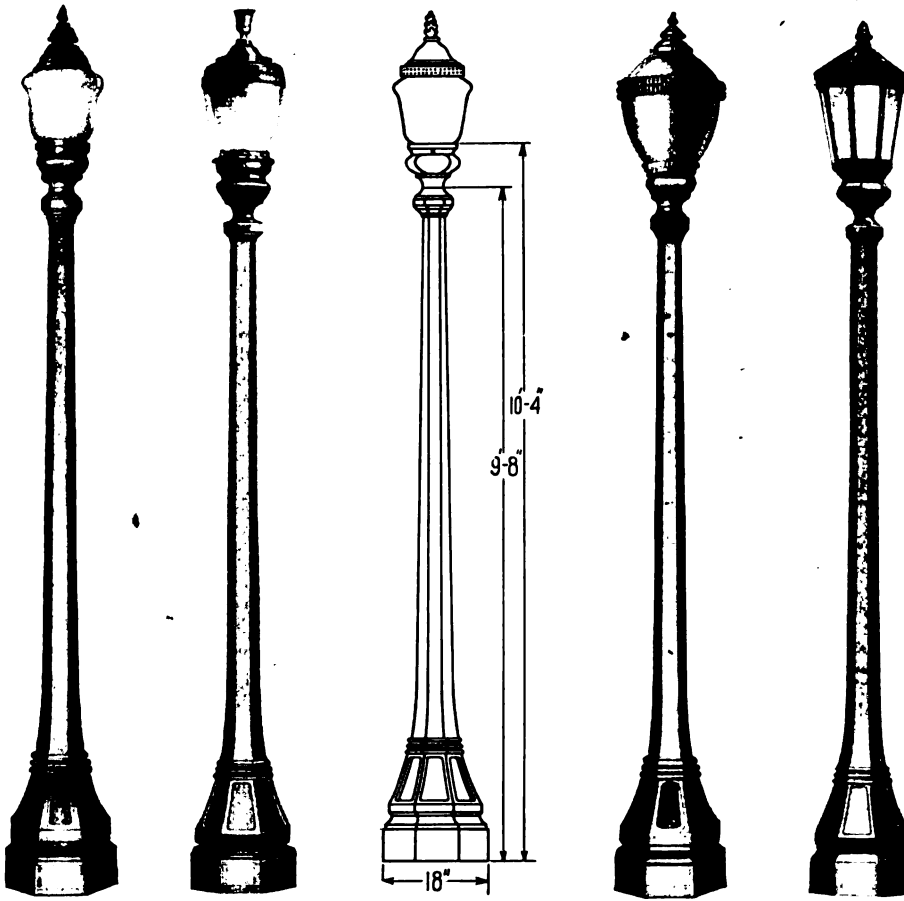
## Edgewater Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket .....	353586	352	\$108 00
With Mogul Multiple Socket .....	353587	352	102 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353588	363	118 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353589	364	119 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353590	368	123 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket .....	353591	354	110 00
With Mogul Multiple Socket .....	353592	354	109 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353593	365	120 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353594	366	121 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-amp. Lamp .....	353595	370	125 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket .....	353581	356	109 00
With Mogul Multiple Socket .....	353582	356	108 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353583	367	119 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353584	368	120 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353585	372	124 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket .....	353576	444	167 00
With Mogul Multiple Socket .....	353577	444	166 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353578	355	177 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353579	356	178 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353580	360	182 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket .....	353601	379	122 00
With Medium Multiple Socket .....	353602	379	120 80
With Mogul Multiple Socket .....	353603	379	121 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp .....	353604	382	134 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp .....	353605	385	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353606	390	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353607	391	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353608	395	137 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket .....	353596	379	117 00
With Mogul Multiple Socket .....	353597	379	116 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353598	390	127 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353599	391	128 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353600	395	132 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket .....	353609	382	122 00
With Mogul Multiple Socket .....	353610	382	121 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353611	393	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353612	394	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353613	398	137 00
<b>With Pagoda Top</b>			
With Regent Film Socket .....	353614	454	149 00
With Mogul Multiple Socket .....	353615	454	148 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	353616	465	159 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	353617	466	160 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	353618	470	164 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Edgewater Junior Posts



STYLE No. 337917

STYLE No. 353644

STYLE No. 353624

STYLE No. 353630

STYLE No. 353636

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Edgewater Junior Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center		Complete Post	STYLE NUMBERS			Ht. to Light Center	
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Jr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
337914	336529	351383	351282	10	11	353632	336529	353387	351322	11	
337919	336529	351383	351284	10	11	353633	336529	353387	351323	11	
337920	336529	351383	351285	10	11	353634	336529	351382	351325	11	1/2
337915	336529	336540	351286	10	11 1/2	353635	336529	351382	351326	11	1/2
337916	336529	336540	351287	10	11 1/2	353636	336529	351382	351327	11	1/2
337917	336529	336540	351288	10	11 1/2	353637	336529	351382	351328	11	1/2
<b>With Sol-Lux Jr. Top, Glass Canopy</b>						<b>With Egyptian Jr. Reflectolux Top, Metal Canopy</b>					
353619	336529	351383	351289	10	11	353638	336529	351382	351329	11	1/2
353620	336529	351383	351291	10	11	353639	336529	353387	351349	11	
353621	336529	351383	351292	10	11	353640	336529	353387	351351	11	
353622	336529	336540	351293	10	11 1/2	353641	336529	353387	351352	11	
353623	336529	336540	351294	10	11 1/2	353642	336529	351382	351354	11	1/2
353624	336529	336540	351295	10	11 1/2	353643	336529	351382	351355	11	1/2
<b>With Meridian Jr. Top</b>						<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
353625	336529	351383	351302	10	11	353644	336529	351382	351356	11	1/2
353626	336529	351383	351304	10	11	353645	336529	353387	351357	11	
353627	336529	351383	351305	10	11	353646	336529	353387	351359	11	
353628	336529	336540	351306	10	11 1/2	353647	336529	353387	351360	11	
353629	336529	336540	351307	10	11 1/2	353648	336529	351382	351362	11	1/2
353630	336529	336540	351308	10	11 1/2	353649	336529	351382	351363	11	1/2
<b>With Octagonal Jr. Reflectolux Top</b>						<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
353631	336529	353387	351320	11		353650	336529	351382	351364	11	1/2

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

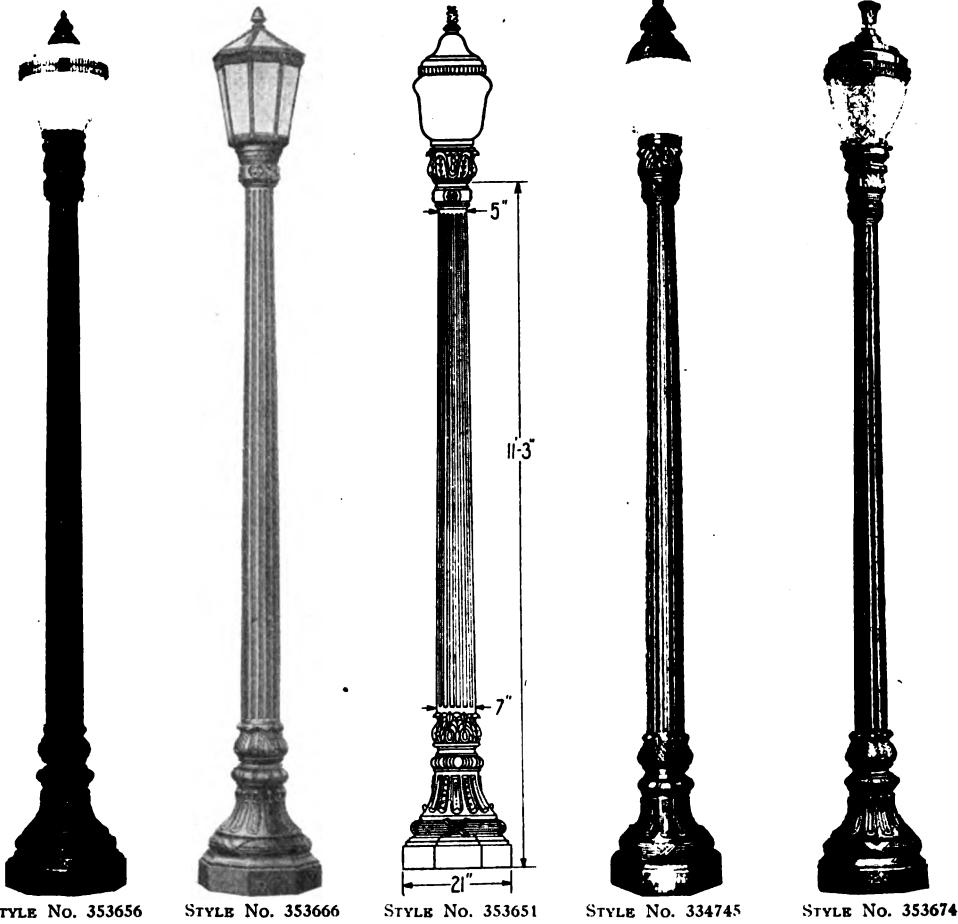
## Edgewater Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	337914	354	\$ 92 00
With Medium Multiple Socket	337919	354	90 90
With Mogul Multiple Socket	337920	354	91 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	337915	357	104 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	337916	360	105 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	337917	365	102 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	353619	356	94 00
With Medium Multiple Socket	353620	356	92 90
With Mogul Multiple Socket	353621	356	93 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353622	359	106 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353623	362	107 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353624	367	104 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	353625	354	93 00
With Medium Multiple Socket	353626	354	91 90
With Mogul Multiple Socket	353627	354	92 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353628	357	105 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353629	360	106 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353630	365	103 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	353631	384	110 80
With Medium Multiple Socket	353632	384	109 50
With Mogul Multiple Socket	353633	384	109 80
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353634	387	122 80
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353635	390	123 80
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353636	395	120 80
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353637	396	122 10
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353638	400	125 80
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	353639	384	103 10
With Medium Multiple Socket	353640	384	102 00
With Mogul Multiple Socket	353641	384	102 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353642	387	115 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353643	390	116 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-amp. Lamp	353644	395	113 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	353645	387	108 10
With Medium Multiple Socket	353646	387	107 00
With Mogul Multiple Socket	353647	387	107 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353648	390	120 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353649	393	121 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353650	398	118 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Commercial Posts



STYLE No. 353656

STYLE No. 353666

STYLE No. 353651

STYLE No. 334745

STYLE No. 353674

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Commercial Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center		Complete Post	STYLE NUMBERS			Ht. to Light Center	
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Sr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
334745	339002	339004	351270	12	7 1/2	353668	339002	353423	351323	12	7 1/2
334782	339002	339004	351271	12	7 1/2	353669	339002	353423	351325	12	7 1/2
348740	339002	339004	351272	12	7 1/2	353670	339002	353423	351326	12	7 1/2
334747	339002	339004	351273	12	7 1/2	353671	339002	353423	351327	12	7 1/2
344741	339002	339004	351274	12	7 1/2	353672	339002	353423	351328	12	7 1/2
<b>With Sol-Lux Sr. Top, Glass Canopy</b>						<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>					
353651	339002	339004	351276	12	7 1/2	353674	339002	353423	351335	12	7 1/2
353652	339002	339004	351278	12	7 1/2	353675	339002	353423	351337	12	7 1/2
353653	339002	339004	351279	12	7 1/2	353676	339002	353423	351339	12	7 1/2
353654	339002	339004	351280	12	7 1/2	353677	339002	353423	351340	12	7 1/2
353655	339002	339004	351281	12	7 1/2	353678	339002	353423	351341	12	7 1/2
<b>With Meridian Sr. Top</b>						<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>					
353656	339002	339004	351296	12	7 1/2	353679	339002	353423	351342	12	7 1/2
353657	339002	339004	351298	12	7 1/2	353680	339002	353423	351344	12	7 1/2
353658	339002	339004	351299	12	7 1/2	353681	339002	353423	351346	12	7 1/2
353659	339002	339004	351300	12	7 1/2	353682	339002	353423	351347	12	7 1/2
353660	339002	339004	351301	12	7 1/2	353683	339002	353423	351348	12	7 1/2
<b>With Octagonal Sr. Reflectolux Top</b>						<b>With Pagoda Top</b>					
353661	339002	353423	351309	12	10 1/2	353684	339002	353423	351366	12	7
353662	339002	353423	351311	12	10 1/2	353685	339002	353423	351367	12	7
353663	339002	353423	351313	12	10 1/2	353686	339002	353423	351384	12	7
353664	339002	353423	351314	12	10 1/2	353687	339002	353423	351386	12	7
353665	339002	353423	351315	12	10 1/2	353688	339002	353423	351388	12	7
<b>With Octagonal Jr. Reflectolux Top</b>											
353666	339002	353423	351320	12	7 1/2						
353667	339002	353423	351322	12	7 1/2						

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

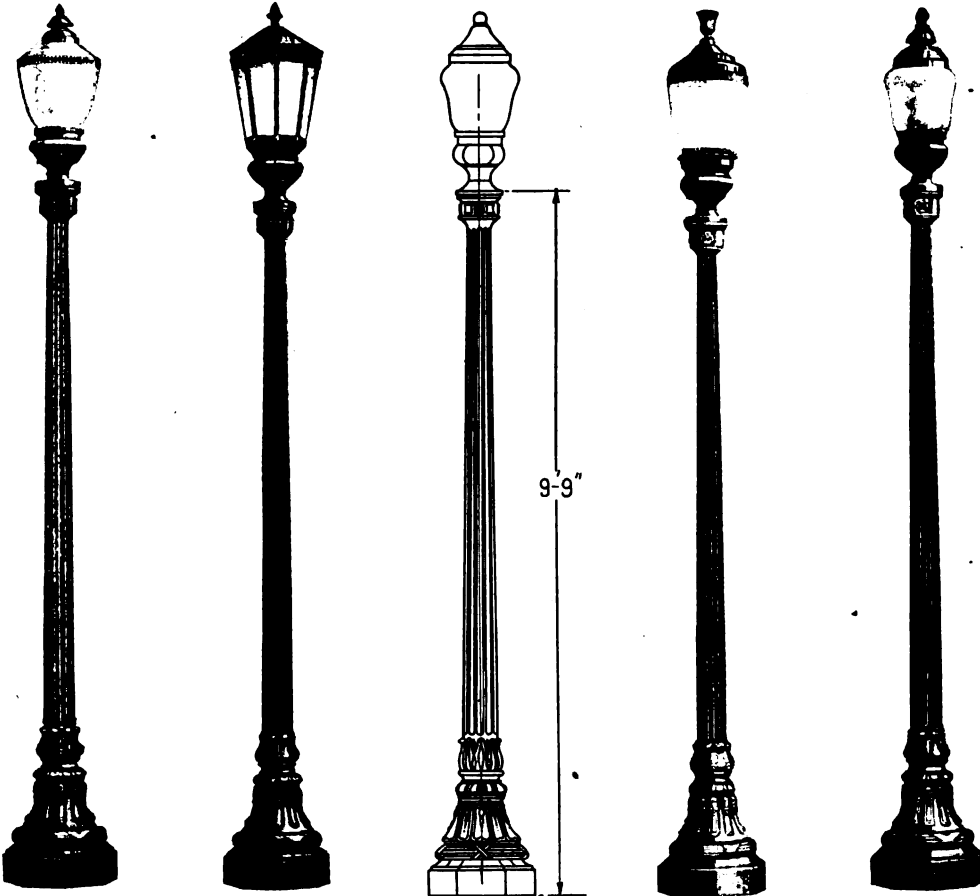
## Commercial Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket	334745	559	\$144 00
With Mogul Multiple Socket	334782	559	143 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	348740	570	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	334747	571	153 50
With Mogul Socket, and Auto-Transformer for 10,000 lumen, 20-ampere Lamp	344741	575	157 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket	353651	561	146 00
With Mogul Multiple Socket	353652	561	145 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353653	572	154 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353654	573	155 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353655	577	159 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket	353656	563	145 00
With Mogul Multiple Socket	353657	563	144 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353658	574	153 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353659	575	154 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, for 20-ampere Lamp	353660	579	158 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket	353661	651	203 00
With Mogul Multiple Socket	353662	651	202 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353663	662	211 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353664	663	212 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, for 20-ampere Lamp	353665	667	216 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	353666	586	158 00
With Medium Multiple Socket	353667	586	156 90
With Mogul Multiple Socket	353668	586	157 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353669	589	168 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353670	592	169 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353671	597	168 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353672	598	167 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353673	602	171 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	353674	586	153 00
With Mogul Multiple Socket	353675	586	152 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353676	597	161 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353677	598	162 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353678	602	166 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	353679	589	158 00
With Mogul Multiple Socket	353680	589	157 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353681	600	166 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353682	601	167 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353683	605	171 00
<b>With Pagoda Top</b>			
With Regent Film Socket	353684	661	185 00
With Mogul Multiple Socket	353685	661	184 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353686	672	193 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353687	673	194 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353688	677	198 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Commercial Junior Posts



STYLE No. 353706

STYLE No. 353712

STYLE No. 353700

STYLE No. 353720

STYLE No. 353694

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Commercial Junior Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center		Complete Post	STYLE NUMBERS			Ht. to Light Center	
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Jr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
353689	352987	339004	351282	11	1	353708	352987	353423	351322	11	2
353690	352987	339004	351284	11	1	353709	352987	353423	351323	11	2
353691	352987	339004	351285	11	1	353710	352987	353423	351325	11	2
353692	352987	339004	351286	11	1	353711	352987	353423	351326	11	2
353693	352987	339004	351287	11	1	353712	352987	353423	351327	11	2
353694	352987	339004	351288	11	1	353713	352987	353423	351328	11	2
						353714	352987	353423	351329	11	2
<b>With Sol-Lux Jr. Top, Glass Canopy</b>						<b>With Egyptian Jr. Reflectolux Top, Metal Canopy</b>					
353695	352987	339004	351289	11	1	353715	352987	353423	351349	11	2
353696	352987	339004	351291	11	1	353716	352987	353423	351351	11	2
353697	352987	339004	351292	11	1	353717	352987	353423	351352	11	2
353698	352987	339004	351293	11	1	353718	352987	353423	351354	11	2
353699	352987	339004	351294	11	1	353719	352987	353423	351355	11	2
353700	352987	339004	351295	11	1	353720	352987	353423	351356	11	2
<b>With Meridian Jr. Top</b>						<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
353701	352987	339004	351302	11	1	353721	352987	353423	351357	11	2
353702	352987	339004	351304	11	1	353722	352987	353423	351359	11	2
353703	352987	339004	351305	11	1	353723	352987	353423	351360	11	2
353704	352987	339004	351306	11	1	353724	352987	353423	351362	11	2
353705	352987	339004	351307	11	1	353725	352987	353423	351363	11	2
353706	352987	339004	351308	11	1	353726	352987	353423	351364	11	2
<b>With Octagonal Jr. Reflectolux Top</b>											
353707	352987	353423	351320	11	2						

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

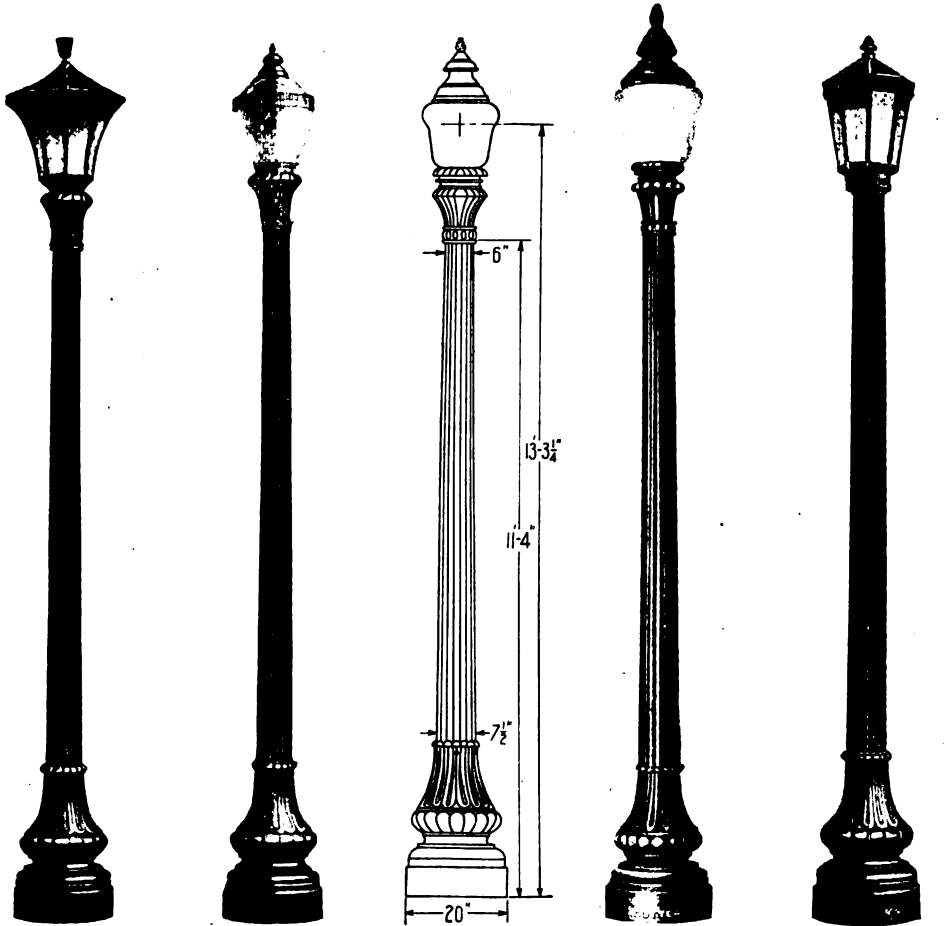
## Commercial Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	353689	395	\$110 00
With Medium Multiple Socket	353690	395	108 90
With Mogul Multiple Socket	353691	395	109 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353692	398	120 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353693	401	121 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353694	406	118 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	353695	397	112 00
With Medium Multiple Socket	353696	397	110 00
With Mogul Multiple Socket	353697	397	111 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353698	400	122 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353699	403	123 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353700	408	120 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	353701	395	111 00
With Medium Multiple Socket	353702	395	109 90
With Mogul Multiple Socket	353703	395	110 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353704	398	121 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353705	401	122 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353706	406	119 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	353707	425	128 60
With Medium Multiple Socket	353708	425	127 50
With Mogul Multiple Socket	353709	425	127 60
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353710	428	138 60
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353711	431	139 60
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353712	436	138 60
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	353713	437	138 10
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	353714	441	141 60
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	353715	425	121 10
With Medium Multiple Socket	353716	425	120 00
With Mogul Multiple Socket	353717	425	120 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353718	428	131 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353719	431	132 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353720	436	129 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	353721	428	126 10
With Medium Multiple Socket	353722	428	125 00
With Mogul Multiple Socket	353723	428	125 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	353724	431	136 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	353725	434	137 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	353726	439	134 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Continental Posts



STYLE NO. 350840      STYLE NO. 350812      STYLE NO. 341826      STYLE NO. 341826      STYLE NO. 350822

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Continental Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center		Complete Post	STYLE NUMBERS			Ht. to Light Center	
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Sr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
341826	338009	336363	351270	13	3 1/2	350824	338009	336294	351323	13	2
341825	338009	336363	351271	13	3 1/2	350825	338009	336294	351325	13	2
350804	338009	336363	351272	13	3 1/2	350826	338009	336294	351326	13	2
350805	338009	336363	351273	13	3 1/2	350827	338009	336294	351327	13	2
350806	338009	336363	351274	13	3 1/2	350828	338009	336294	351328	13	2
<b>With Sol-Lux Sr. Top, Glass Canopy</b>						<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>					
350807	338009	336363	351276	13	3 1/2	350830	338009	336294	351335	13	2
350808	338009	336363	351278	13	3 1/2	350831	338009	336294	351337	13	2
350809	338009	336363	351279	13	3 1/2	350832	338009	336294	351339	13	2
350810	338009	336363	351280	13	3 1/2	350833	338009	336294	351340	13	2
350811	338009	336363	351281	13	3 1/2	350834	338009	336294	351341	13	2
<b>With Meridian Sr. Top</b>						<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>					
350812	338009	336363	351296	13	3 1/2	350835	338009	336294	351342	13	2
350813	338009	336363	351298	13	3 1/2	350836	338009	336294	351344	13	2
350814	338009	336363	351299	13	3 1/2	350837	338009	336294	351346	13	2
350815	338009	336363	351300	13	3 1/2	350838	338009	336294	351347	13	2
350816	338009	336363	351301	13	3 1/2	350839	338009	336294	351348	13	2
<b>With Octagonal Sr. Reflectolux Top</b>						<b>With Pagoda Top</b>					
350817	338009	336294	351309	13	4 1/2	350840	338009	336294	351365	13	1 1/2
350818	338009	336294	351311	13	4 1/2	350841	338009	336294	351367	13	1 1/2
350819	338009	336294	351313	13	4 1/2	350842	338009	336294	351368	13	1 1/2
350820	338009	336294	351314	13	4 1/2	350843	338009	336294	351369	13	1 1/2
350821	338009	336294	351315	13	4 1/2	350844	338009	336294	351386	13	1 1/2
<b>With Octagonal Jr. Reflectolux Top</b>											
350822	338009	336294	351320	13	2						
350823	338009	336294	351322	13	2						

Order by Style Number



## CUTTER SINGLE-LIGHT POSTS—Continued

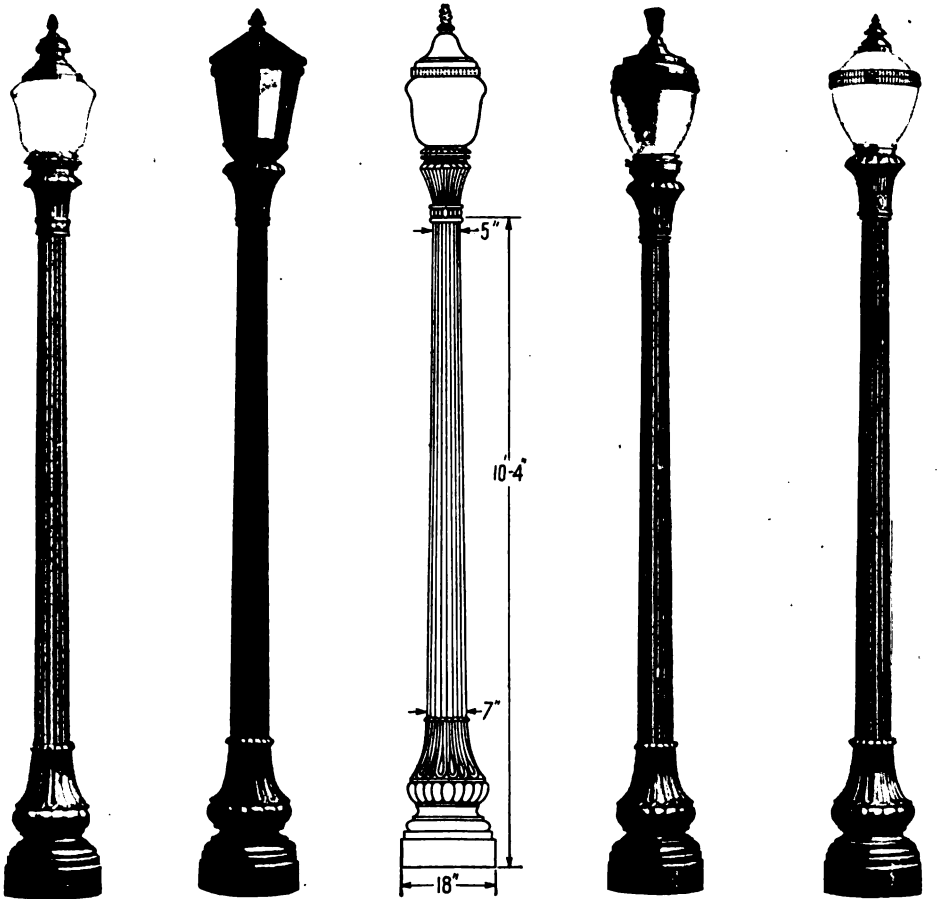
## Continental Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket.....	341826	638	\$135 00
With Mogul Multiple Socket.....	341825	638	134 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350804	649	143 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350805	650	144 50
With Mogul Socket, and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350806	654	148 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket.....	350807	640	137 00
With Mogul Multiple Socket.....	350808	640	136 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350809	651	145 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350810	652	146 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350811	656	150 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket.....	350812	642	136 00
With Mogul Multiple Socket.....	350813	642	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350814	653	144 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350815	654	145 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350816	658	149 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket.....	350817	699	194 00
With Mogul Multiple Socket.....	350818	699	193 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350819	710	202 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350820	711	203 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350821	715	207 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket.....	350822	634	149 00
With Medium Multiple Socket.....	350823	634	147 90
With Mogul Multiple Socket.....	350824	634	148 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp.....	350825	637	159 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp.....	350826	640	160 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350827	645	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350828	646	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350829	650	162 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket.....	350830	634	144 00
With Mogul Multiple Socket.....	350831	634	143 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350832	645	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350833	646	153 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350834	650	157 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket.....	350835	637	149 00
With Mogul Multiple Socket.....	350836	637	148 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350837	648	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350838	649	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350839	653	162 00
<b>With Pagoda Top</b>			
With Regent Film Socket.....	350840	709	176 00
With Mogul Multiple Socket.....	350841	709	175 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	350842	720	184 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	350843	721	185 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	350844	725	189 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Continental Medium Posts



STYLE No. 341828

STYLE No. 350863

STYLE No. 350848

STYLE No. 350871

STYLE No. 350853

Complete posts are made up in various combinations of three principal parts: column, casing and top. Continental Medium Posts as listed on the opposite page are made up in the following combinations.

STYLE NUMBERS				Ht. to Light Center	Ft.	In.	STYLE NUMBERS				Ht. to Light Center	Ft.	In.
Complete Post	Column	Casing	Top				Complete Post	Column	Casing	Top			
<b>With Sol-Lux Sr. Top, Metal Canopy</b>													
341828	336311	336363	351270	12	3	1/2	350865	336311	336294	351323	12	2	
341827	336311	336363	351271	12	3	1/2	350866	336311	336294	351325	12	2	
350845	336311	336363	351272	12	3	1/2	350867	336311	336294	351326	12	2	
350846	336311	336363	351273	12	3	1/2	350868	336311	336294	351327	12	2	
350847	336311	336363	351274	12	3	1/2	350869	336311	336294	351328	12	2	
<b>With Sol-Lux Sr. Top, Glass Canopy</b>													
350848	336311	336363	351276	12	3	1/2	350870	336311	336294	351329	12	2	
350849	336311	336363	351278	12	3	1/2	<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>						
350850	336311	336363	351279	12	3	1/2	350871	336311	336294	351335	12	2	
350851	336311	336363	351280	12	3	1/2	350872	336311	336294	351337	12	2	
350852	336311	336363	351281	12	3	1/2	350873	336311	336294	351339	12	2	
<b>With Meridian Sr. Top</b>													
350853	336311	336363	351296	12	3	1/2	350874	336311	336294	351340	12	2	
350854	336311	336363	351298	12	3	1/2	350875	336311	336294	351341	12	2	
350855	336311	336363	351299	12	3	1/2	<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>						
350856	336311	336363	351300	12	3	1/2	350876	336311	336294	351342	12	2	
350857	336311	336363	351301	12	3	1/2	350877	336311	336294	351344	12	2	
<b>With Octagonal Sr. Reflectolux Top</b>													
350858	336311	336294	351309	12	4	1/2	350878	336311	336294	351346	12	2	
350859	336311	336294	351311	12	4	1/2	350879	336311	336294	351347	12	2	
350860	336311	336294	351313	12	4	1/2	350880	336311	336294	351348	12	2	
350861	336311	336294	351314	12	4	1/2	<b>With Pagoda Top</b>						
350862	336311	336294	351315	12	4	1/2	350881	336311	336294	351365	12	1 1/2	
<b>With Octagonal Jr. Reflectolux Top</b>													
350863	336311	336294	351320	12	2		350882	336311	336294	351367	12	1 1/2	
350864	336311	336294	351322	12	2		350883	336311	336294	351364	12	1 1/2	
							350884	336311	336294	351365	12	1 1/2	
							350885	336311	336294	351366	12	1 1/2	

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

## Continental Medium Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket	341828	549	\$110 00
With Mogul Multiple Socket	341827	549	109 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350845	560	118 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350846	561	119 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350847	565	123 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket	350848	551	112 00
With Mogul Multiple Socket	350849	551	111 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350850	562	120 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350851	563	121 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350852	567	125 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket	350853	553	111 00
With Mogul Multiple Socket	350854	553	110 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350855	564	119 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350856	565	120 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350857	569	124 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket	350858	610	169 00
With Mogul Multiple Socket	350859	610	168 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350860	621	177 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350861	622	178 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350862	626	182 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	350863	545	124 00
With Medium Multiple Socket	350864	545	122 90
With Mogul Multiple Socket	350865	545	123 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350866	548	134 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350867	551	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350868	556	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350869	557	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350870	561	137 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	350871	545	119 00
With Mogul Multiple Socket	350872	545	118 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350873	556	127 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350874	557	128 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350875	561	132 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	350876	548	124 00
With Mogul Multiple Socket	350877	548	123 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350878	559	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350879	560	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350880	564	137 00
<b>With Pagoda Top</b>			
With Regent Film Socket	350881	620	151 00
With Mogul Multiple Socket	350882	620	150 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350883	631	159 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350884	632	160 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350885	636	164 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

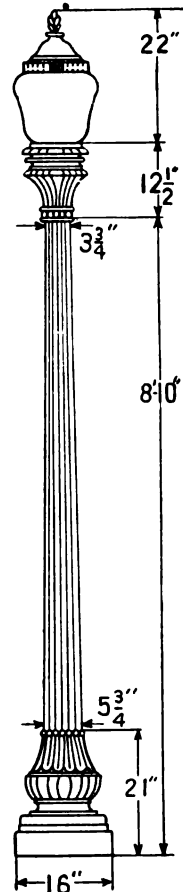
Continental Junior Posts



STYLE No. 350909



STYLE No. 350895



STYLE No. 350889



STYLE No. 350901



STYLE No. 341831

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Continental Junior Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center		Complete Post	STYLE NUMBERS			Ht. to Light Center	
	Column	Casing	Top	Ft.	In.		Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Jr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top</b>					
341831	336016	351380	351282	10	8 1/2	350901	336016	351381	351320	10	7
341829	336016	351380	351284	10	8 1/2	350902	336016	351381	351322	10	7
341830	336016	351380	351285	10	8 1/2	350903	336016	351381	351323	10	7
350886	336016	336364	351286	10	8 1/2	350904	336016	336293	351325	10	7
350887	336016	336364	351287	10	8 1/2	350905	336016	336293	351326	10	7
350888	336016	336364	351288	10	8 1/2	350906	336016	336293	351327	10	7
						350907	336016	336293	351328	10	7
						350908	336016	336293	351329	10	7
<b>With Sol-Lux Jr. Top, Glass Canopy</b>						<b>With Egyptian Jr. Reflectolux Top, Metal Canopy</b>					
350889	336016	351380	351289	10	8 1/2	350909	336016	351381	351349	10	7
350890	336016	351380	351291	10	8 1/2	350910	336016	351381	351351	10	7
350891	336016	351380	351292	10	8 1/2	350911	336016	351381	351352	10	7
350892	336016	336364	351293	10	8 1/2	350912	336016	336293	351354	10	7
350893	336016	336364	351294	10	8 1/2	350913	336016	336293	351355	10	7
350894	336016	336364	351295	10	8 1/2	350914	336016	336293	351356	10	7
<b>With Meridian Jr. Top</b>						<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
350895	336016	351380	351302	10	8 1/2	350915	336016	351381	351357	10	7
350896	336016	351380	351304	10	8 1/2	350916	336016	351381	351359	10	7
350897	336016	351380	351305	10	8 1/2	350917	336016	351381	351360	10	7
350898	336016	336364	351306	10	8 1/2	350918	336016	336293	351362	10	7
350899	336016	336364	351307	10	8 1/2	350919	336016	336293	351363	10	7
350900	336016	336364	351308	10	8 1/2	350920	336016	336293	351364	10	7

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

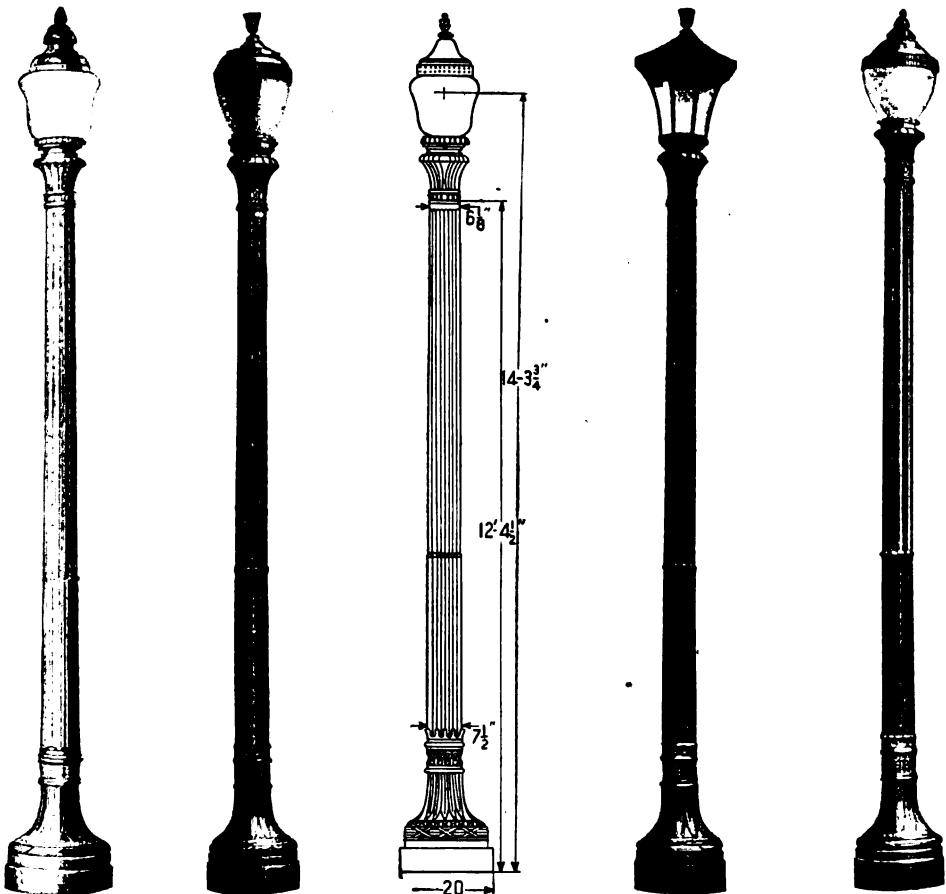
## Continental Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	341831	373	\$83 00
With Medium Multiple Socket	341829	373	81 90
With Mogul Multiple Socket	341830	373	82 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350886	376	95 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350887	379	96 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350888	384	93 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	350889	375	85 00
With Medium Multiple Socket	350890	375	83 90
With Mogul Multiple Sockets	350891	375	84 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350892	378	97 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350893	381	98 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350894	386	95 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	350895	373	84 00
With Medium Multiple Socket	350896	373	82 90
With Mogul Multiple Socket	350897	373	83 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350898	376	96 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350899	379	97 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350900	384	94 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	350901	366	101 60
With Medium Multiple Socket	350902	366	100 50
With Mogul Multiple Socket	350903	366	100 60
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350904	369	113 60
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350905	372	114 60
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350906	377	111 60
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	350907	378	113 10
With Mogul-Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	350908	382	116 60
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	350909	366	94 10
With Medium Multiple Socket	350910	366	93 00
With Mogul Multiple Socket	350911	366	93 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350912	369	106 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350913	372	107 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350914	377	104 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	350915	369	99 10
With Medium Multiple Socket	350916	369	98 00
With Mogul Multiple Socket	350917	369	98 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	350918	372	111 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	350919	375	112 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	350920	380	109 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Capitol Posts



STYLE No. 341843

STYLE No. 350947

STYLE No. 350924

STYLE No. 350957

STYLE No. 350929

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Capitol Posts as listed complete on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.	Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.
	Column	Casing	Top			Column	Casing	Top	
<b>With Sol-Lux Sr. Top, Metal Canopy</b>									
341843	338022	336363	351270	14 4	350941	338022	338294	351323	14 2 1/4
341842	338022	336363	351271	14 4	350942	338022	338294	351325	14 2 1/4
350921	338022	336363	351272	14 4	350943	338022	338294	351326	14 2 1/4
350922	338022	336363	351273	14 4	350944	338022	338294	351327	14 2 1/4
350923	338022	336363	351274	14 4	350945	338022	338294	351328	14 2 1/4
					350946	338022	338294	351329	14 2 1/4
<b>With Sol-Lux Sr. Top, Glass Canopy</b>									
350924	338022	336363	351276	14 4	<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>				
350925	338022	336363	351278	14 4	350947	338022	338294	351335	14 2 1/4
350926	338022	336363	351279	14 4	350948	338022	338294	351337	14 2 1/4
350927	338022	336363	351280	14 4	350949	338022	338294	351339	14 2 1/4
350928	338022	336363	351281	14 4	350950	338022	338294	351340	14 2 1/4
					350951	338022	338294	351341	14 2 1/4
<b>With Meridian Sr. Top</b>									
350929	338022	336363	351296	14 4	<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>				
350930	338022	336363	351298	14 4	350952	338022	338294	351342	14 2 1/4
350931	338022	336363	351299	14 4	350953	338022	338294	351344	14 2 1/4
350932	338022	336363	351300	14 4	350954	338022	338294	351346	14 2 1/4
350933	338022	336363	351301	14 4	350955	338022	338294	351347	14 2 1/4
					350956	338022	338294	351348	14 2 1/4
<b>With Octagonal Sr. Reflectolux Top</b>									
350934	338022	338294	351309	14 5	<b>With Pagoda Top</b>				
350935	338022	338294	351311	14 5	350957	338022	338294	351365	14 2
350936	338022	338294	351313	14 5	350958	338022	338294	351367	14 2
350937	338022	338294	351314	14 5	350959	338022	338294	351384	14 2
350938	338022	338294	351315	14 5	350960	338022	338294	351385	14 2
					350961	338022	338294	351386	14 2
<b>With Octagonal Jr. Reflectolux Top</b>									
350939	338022	338294	351320	14 2 1/2					
350940	338022	338294	351322	14 2 1/2					

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

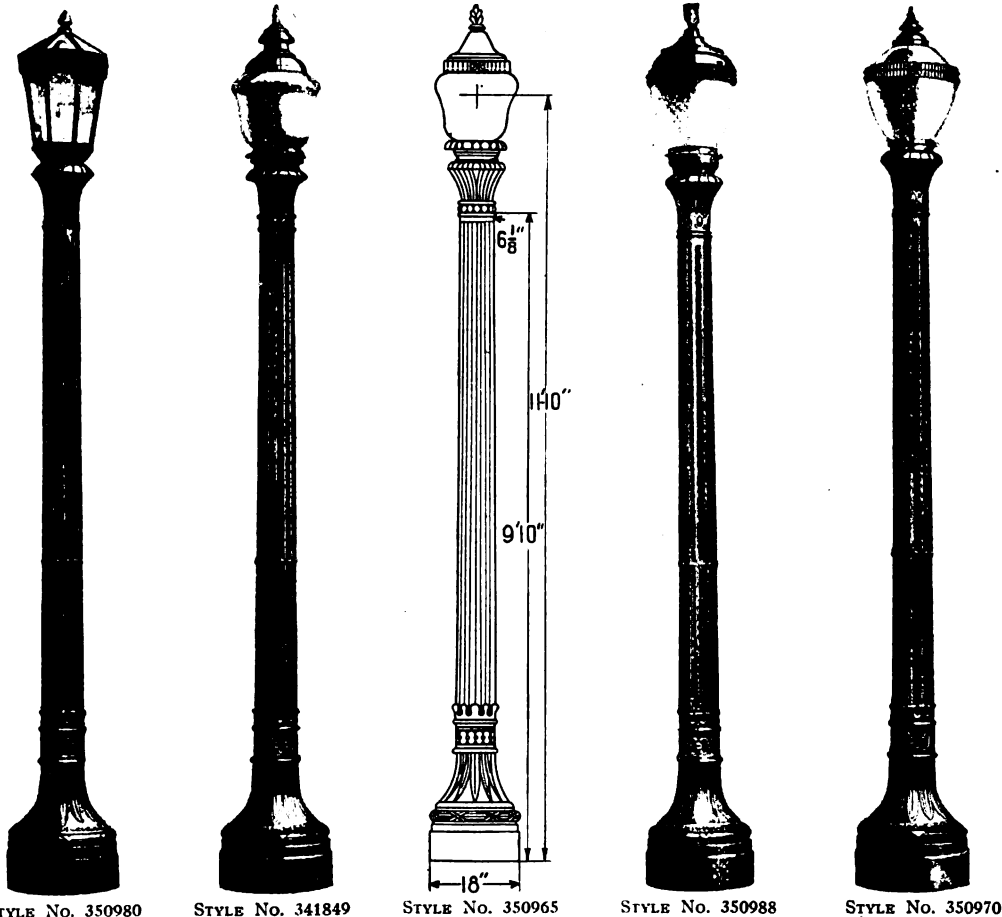
## Capitol Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket .....	341843	617	\$135 00
With Mogul Multiple Socket .....	341842	617	134 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350921	628	143 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350922	629	144 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350923	633	148 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket .....	350924	619	137 00
With Mogul Multiple Socket .....	350925	619	138 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350926	630	145 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350927	631	146 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350928	635	150 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket .....	350929	621	136 00
With Mogul Multiple Socket .....	350930	621	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350931	632	144 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350932	633	145 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350933	637	149 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket .....	350934	678	194 00
With Mogul Multiple Socket .....	350935	678	193 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350936	689	202 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350937	690	203 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350938	694	207 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket .....	350939	613	149 00
With Medium Multiple Socket .....	350940	613	147 90
With Mogul Multiple Socket .....	350941	613	148 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp .....	350942	616	159 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp .....	350943	619	160 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350944	624	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350945	625	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350946	629	162 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket .....	350947	613	144 00
With Mogul Multiple Socket .....	350948	613	143 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350949	624	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350950	625	153 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350951	629	157 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket .....	350952	616	149 00
With Mogul Multiple Socket .....	350953	616	148 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350954	627	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350955	628	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350956	632	162 00
<b>With Pagoda Top</b>			
With Regent Film Socket .....	350957	688	176 00
With Mogul Multiple Socket .....	350958	688	175 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350959	699	184 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350960	700	185 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350961	704	189 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Capitol Junior Posts



STYLE No. 350980      STYLE No. 341849      STYLE No. 350965      STYLE No. 350988      STYLE No. 350970

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Capitol Junior Posts as listed on the opposite page are made up in the following combinations, which are listed and illustrated elsewhere in this section.

STYLE NUMBERS				Ht. to Light Center Ft. In.	STYLE NUMBERS				Ht. to Light Center Ft. In.
Complete Post	Column	Casing	Top		Complete Post	Column	Casing	Top	
<b>With Sol-Lux Sr. Top, Metal Canopy</b>					<b>With Octagonal Jr. Reflectolux Top—Continued</b>				
341849	336102	336363	351270	11 9	350982	336102	336294	351323	11 7 1/2
341848	336102	336363	351271	11 9	350983	336102	336294	351325	11 7 1/2
350982	336102	336363	351272	11 9	350984	336102	336294	351326	11 7 1/2
350983	336102	336363	351273	11 9	350985	336102	336294	351327	11 7 1/2
350984	336102	336363	351274	11 9	350986	336102	336294	351328	11 7 1/2
350985	336102	336363	351275	11 9	350987	336102	336294	351329	11 7 1/2
350986	336102	336363	351276	11 9	<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>				
350987	336102	336363	351278	11 9	350988	336102	336294	351335	11 7 1/2
350988	336102	336363	351278	11 9	350989	336102	336294	351337	11 7 1/2
350989	336102	336363	351279	11 9	350990	336102	336294	351339	11 7 1/2
350990	336102	336363	351280	11 9	350991	336102	336294	351340	11 7 1/2
350991	336102	336363	351281	11 9	350992	336102	336294	351341	11 7 1/2
<b>With Meridian Sr. Top</b>					<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>				
350970	336102	336363	351296	11 9	350993	336102	336294	351342	11 7 1/2
350971	336102	336363	351298	11 9	350994	336102	336294	351344	11 7 1/2
350972	336102	336363	351299	11 9	350995	336102	336294	351346	11 7 1/2
350973	336102	336363	351300	11 9	350996	336102	336294	351347	11 7 1/2
350974	336102	336363	351301	11 9	350997	336102	336294	351348	11 7 1/2
<b>With Octagonal Sr. Reflectolux Top</b>					<b>With Pagoda Top</b>				
350975	336102	336294	351309	11 10	350998	336102	336294	351365	11 7
350976	336102	336294	351311	11 10	350999	336102	336294	351367	11 7
350977	336102	336294	351313	11 10	351000	336102	336294	351384	11 7
350978	336102	336294	351314	11 10	351001	336102	336294	351385	11 7
350979	336102	336294	351315	11 10	351002	336102	336294	351386	11 7
<b>With Octagonal Jr. Reflectolux Top</b>									
350980	336102	336294	351320	11 7 1/2					
350981	336102	336294	351322	11 7 1/2					

Order by Style Number



## CUTTER SINGLE-LIGHT POSTS—Continued

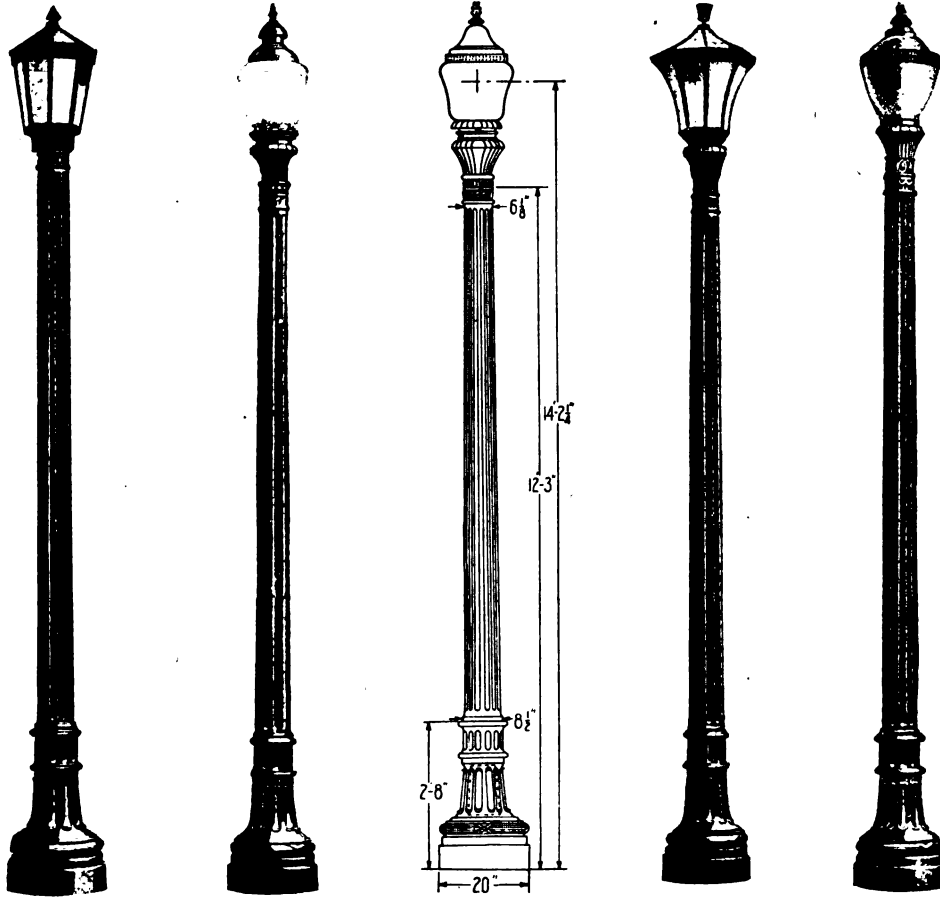
## Capitol Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket .....	341849	562	\$125 00
With Mogul Multiple Socket .....	341848	562	124 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350962	573	133 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350963	574	134 50
With Mogul Socket, and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350964	578	138 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket .....	350965	564	137 00
With Mogul Multiple Socket .....	350966	564	136 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350967	575	135 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350968	576	136 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350969	580	140 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket .....	350970	566	126 00
With Mogul Multiple Socket .....	350971	566	125 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350972	577	134 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350973	578	135 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350974	582	139 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket .....	350975	623	184 00
With Mogul Multiple Socket .....	350976	623	183 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350977	634	192 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350978	635	193 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350979	639	197 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket .....	350980	558	139 00
With Medium Multiple Socket .....	350981	558	137 90
With Mogul Multiple Socket .....	350982	558	138 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp .....	350983	561	149 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp .....	350984	564	150 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350985	569	147 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350986	570	148 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350987	574	152 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket .....	350988	558	134 00
With Mogul Multiple Socket .....	350989	558	133 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350990	569	142 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350991	570	143 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350992	574	147 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket .....	350993	561	139 00
With Mogul Multiple Socket .....	350994	561	138 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	350995	572	147 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	350996	573	148 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	350997	577	152 00
<b>With Pagoda Top</b>			
With Regent Film Socket .....	350998	633	166 00
With Mogul Multiple Socket .....	350999	633	165 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351000	644	174 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351001	645	175 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351002	649	179 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Broadway Posts



STYLE No. 351021

STYLE No. 341855

STYLE No. 351006

STYLE No. 351039

STYLE No. 351011

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Broadway Posts as listed on the opposite page are made up in the following combinations.

STYLE NUMBERS				Ht. to Light Center		STYLE NUMBERS				Ht. to Light Center	
Complete Post	Column	Casing	Top	Ft.	In.	Complete Post	Column	Casing	Top	Ft.	In.
<b>With Sol-Lux Sr. Top, Metal Canopy</b>						<b>With Octagonal Jr. Reflectolux Top—Continued</b>					
341855	352810	336363	351270	14	2 1/2	351023	352810	336294	351323	14	1
341854	352810	336363	351271	14	2 1/2	351024	352810	336294	351325	14	1
351003	352810	336363	351272	14	2 1/2	351025	352810	336294	351326	14	1
351004	352810	336363	351273	14	2 1/2	351026	352810	336294	351327	14	1
351005	352810	336363	351274	14	2 1/2	351027	352810	336294	351328	14	1
						351028	352810	336294	351329	14	1
<b>With Sol-Lux Sr. Top, Glass Canopy</b>						<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>					
351006	352810	336363	351276	14	2 1/2	351029	352810	336294	351335	14	1
351007	352810	336363	351278	14	2 1/2	351030	352810	336294	351337	14	1
351008	352810	336363	351279	14	2 1/2	351031	352810	336294	351339	14	1
351009	352810	336363	351280	14	2 1/2	351032	352810	336294	351340	14	1
351010	352810	336363	351281	14	2 1/2	351033	352810	336294	351341	14	1
<b>With Meridian Sr. Top</b>						<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>					
351011	352810	336363	351296	14	2 1/2	351034	352810	336294	351342	14	1
351012	352810	336363	351298	14	2 1/2	351035	352810	336294	351344	14	1
351013	352810	336363	351299	14	2 1/2	351036	352810	336294	351346	14	1
351014	352810	336363	351300	14	2 1/2	351037	352810	336294	351347	14	1
351015	352810	336363	351301	14	2 1/2	351038	352810	336294	351348	14	1
<b>With Octagonal Sr. Reflectolux Top</b>						<b>With Pagoda Top</b>					
351016	352810	336294	351309	14	3 1/2	351039	352810	336294	351365	14	1 1/2
351017	352810	336294	351311	14	3 1/2	351040	352810	336294	351367	14	1 1/2
351018	352810	336294	351313	14	3 1/2	351041	352810	336294	351384	14	1 1/2
351019	352810	336294	351314	14	3 1/2	351042	352810	336294	351385	14	1 1/2
351020	352810	336294	351315	14	3 1/2	351043	352810	336294	351386	14	1 1/2
<b>With Octagonal Jr. Reflectolux Top</b>											
351021	352810	336294	351320	14	1						
351022	352810	336294	351322	14	1						

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

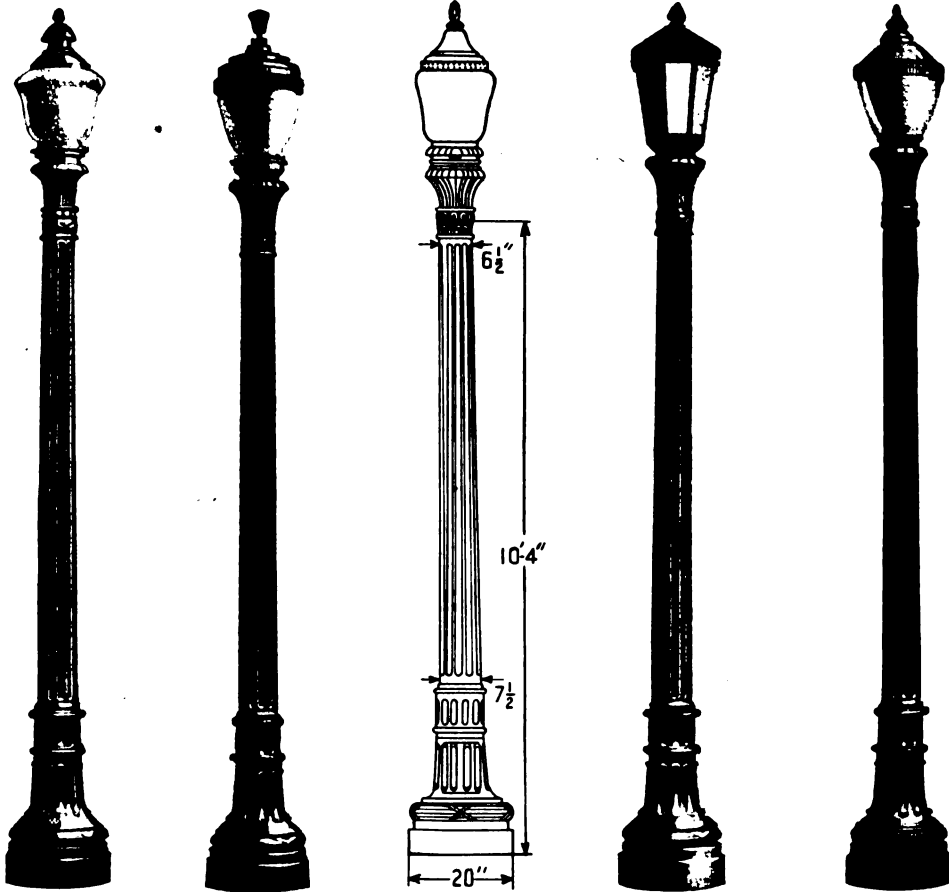
## Broadway Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket.....	341855	659	\$135 00
With Mogul Multiple Socket.....	341854	659	134 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351003	670	143 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351004	671	144 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351005	675	148 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket.....	351006	661	137 00
With Mogul Multiple Socket.....	351007	661	136 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351008	672	145 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351009	673	146 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351010	677	150 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket.....	351011	663	136 00
With Mogul Multiple Socket.....	351012	663	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351013	674	144 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351014	675	145 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351015	679	149 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket.....	351016	720	194 00
With Mogul Multiple Socket.....	351017	720	193 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351018	731	202 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351019	732	203 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351020	736	207 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket.....	351021	655	149 00
With Medium Multiple Socket.....	351022	655	147 90
With Mogul Multiple Socket.....	351023	655	148 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp.....	351024	658	159 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp.....	351025	661	160 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351026	666	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351027	667	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351028	671	162 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket.....	351029	655	144 00
With Mogul Multiple Socket.....	351030	655	143 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351031	666	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351032	667	153 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351033	671	157 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket.....	351034	658	149 00
With Mogul Multiple Socket.....	351035	658	148 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351036	669	157 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351037	670	158 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351038	674	162 00
<b>With Pagoda Top</b>			
With Regent Film Socket.....	351039	730	176 00
With Mogul Multiple Socket.....	351041	730	175 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351042	741	184 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351043	742	185 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351044	746	189 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Broadway Junior Posts



STYLE No. 341861    STYLE No. 351072    STYLE No. 351048    STYLE No. 351064    STYLE No. 351053

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Broadway Junior Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.	Complete Post	STYLE NUMBERS			Ht. to Light Center Ft. In.
	Column	Casing	Top			Column	Casing	Top	
<b>With Sol-Lux Sr. Top, Metal Canopy</b>					<b>With Octagonal Jr. Reflectolux Top—Continued</b>				
341861	335752	336363	351270	12 2 1/2	351066	335752	336294	351323	12 1
341860	335752	336363	351271	12 2 1/2	351067	335752	336294	351325	12 1
351045	335752	336363	351272	12 2 1/2	351068	335752	336294	351326	12 1
351046	335752	336363	351273	12 2 1/2	351069	335752	336294	351327	12 1
351047	335752	336363	351274	12 2 1/2	351070	335752	336294	351328	12 1
<b>With Sol-Lux Sr. Top, Glass Canopy</b>					<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>				
351048	335752	336363	351278	12 2 1/2	351072	335752	336294	351335	12 1
351049	335752	336363	351278	12 2 1/2	351073	335752	336294	351337	12 1
351050	335752	336363	351279	12 2 1/2	351074	335752	336294	351339	12 1
351051	335752	336363	351280	12 2 1/2	351076	335752	336294	351340	12 1
351052	335752	336363	351281	12 2 1/2	351077	335752	336294	351341	12 1
<b>With Meridian Sr. Top</b>					<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>				
351053	335752	336363	351296	12 2 1/2	351078	335752	336294	351342	12 1
351054	335752	336363	351298	12 2 1/2	351079	335752	336294	351344	12 1
351055	335752	336363	351299	12 2 1/2	351080	335752	336294	351346	12 1
351056	335752	336363	351300	12 2 1/2	351081	335752	336294	351347	12 1
351057	335752	336363	351301	12 2 1/2	351082	335752	336294	351348	12 1
<b>With Octagonal Sr. Reflectolux Top</b>					<b>With Pagoda Top</b>				
351058	335752	336294	351309	12 3 1/2	351083	335752	336294	351365	12 3/4
351059	335752	336294	351311	12 3 1/2	351084	335752	336294	351367	12 3/4
351061	335752	336294	351313	12 3 1/2	351085	335752	336294	351368	12 3/4
351062	335752	336294	351314	12 3 1/2	351086	335752	336294	351369	12 3/4
351063	335752	336294	351315	12 3 1/2	351087	335752	336294	351368	12 3/4
<b>With Octagonal Jr. Reflectolux Top</b>									
351064	335752	336294	351320	12 1					
351065	335752	336294	351322	12 1					

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

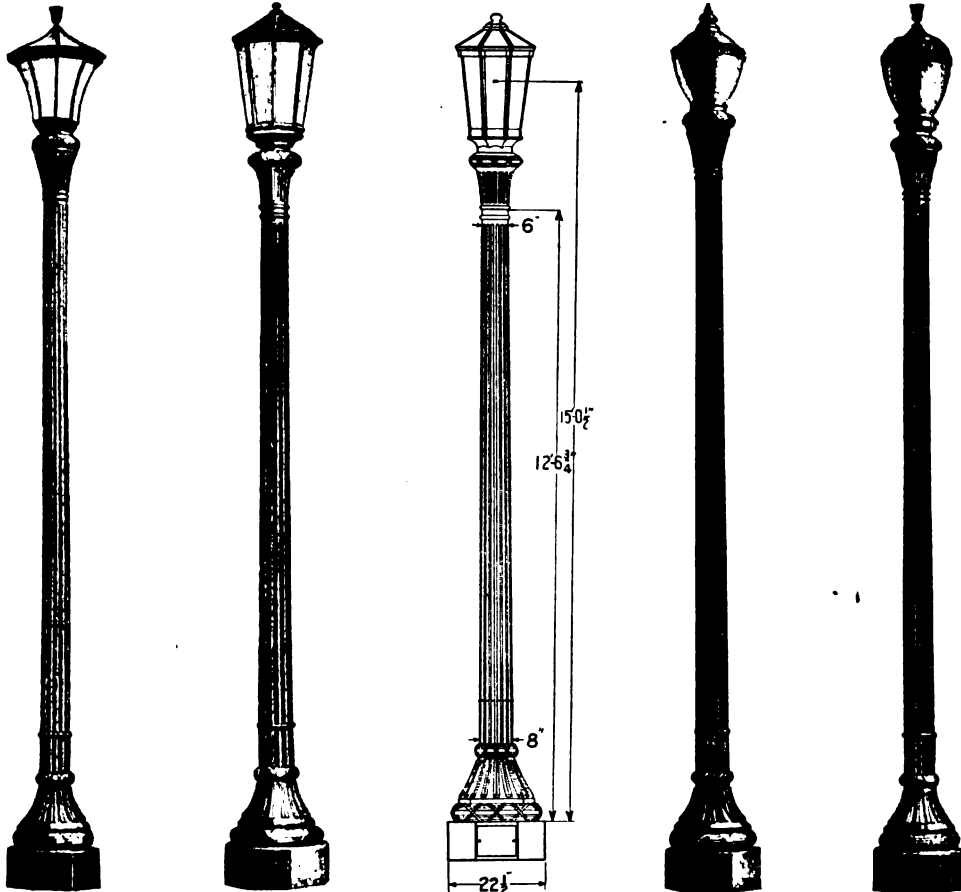
## Broadway Junior Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket .....	341861	579	\$130 00
With Mogul Multiple Socket .....	341860	579	129 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351045	590	138 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351046	591	139 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351047	595	143 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket .....	351048	581	132 00
With Mogul Multiple Socket .....	351049	581	131 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351050	592	140 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351051	593	141 50
With Mogul Socket and Auto-Transformer 10,000-lumen, 20-ampere Lamp .....	351052	597	145 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket .....	351053	583	131 00
With Mogul Multiple Socket .....	351054	583	130 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351055	594	139 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351056	595	140 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351057	599	144 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket .....	351058	640	189 00
With Mogul Multiple Socket .....	351059	640	188 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351061	651	197 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351062	652	198 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351063	656	202 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket .....	351064	575	144 00
With Medium Multiple Socket .....	351065	575	142 90
With Mogul Multiple Socket .....	351066	575	143 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp .....	351067	578	154 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp .....	351068	581	155 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351069	586	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351070	587	153 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351071	591	157 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket .....	351072	575	139 00
With Mogul Multiple Socket .....	351073	575	138 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351074	586	147 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351076	587	146 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351077	591	152 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket .....	351078	578	144 00
With Mogul Multiple Socket .....	351079	578	143 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351080	589	152 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351081	590	153 00
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351082	594	157 00
<b>With Pagoda Top</b>			
With Regent Film Socket .....	351083	650	171 00
With Mogul Multiple Socket .....	351084	650	170 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351085	661	179 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351086	662	180 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351087	666	184 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Grand View Posts



STYLE No. 351126

STYLE No. 351103

STYLE No. 351103

STYLE No. 351098

STYLE No. 351116

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Grand View Posts as listed on the opposite page are made up in the following combinations.

STYLE NUMBERS				Ht. to Light Center Ft. In.	STYLE NUMBERS				Ht. to Light Center Ft. In.
Complete Post	Column	Casing	Top		Complete Post	Column	Casing	Top	
<b>With Sol-Lux Sr. Top, Metal Canopy</b>					<b>With Octagonal Jr. Reflectolux Top—Continued</b>				
351088	353737	353741	351270	15 1 1/2	351110	353737	353736	351323	15 1 1/2
351089	353737	353741	351271	15 1 1/2	351111	353737	353736	351325	15 1 1/2
351090	353737	353741	351272	15 1 1/2	351112	353737	353736	351326	15 1 1/2
351091	353737	353741	351273	15 1 1/2	351113	353737	353736	351327	15 1 1/2
351092	353737	353741	351274	15 1 1/2	351114	353737	353736	351328	15 1 1/2
					351115	353737	353736	351329	15 1 1/2
<b>With Sol-Lux Sr. Top, Glass Canopy</b>					<b>With Egyptian Sr. Reflectolux Top, Metal Canopy</b>				
351093	353737	353741	351276	15 1 1/2	351116	353737	353736	351335	15 1 1/2
351094	353737	353741	351278	15 1 1/2	351117	353737	353736	351337	15 1 1/2
351095	353737	353741	351279	15 1 1/2	351118	353737	353736	351339	15 1 1/2
351096	353737	353741	351280	15 1 1/2	351119	353737	353736	351340	15 1 1/2
351097	353737	353741	351281	15 1 1/2	351120	353737	353736	351341	15 1 1/2
<b>With Meridian Sr. Top</b>					<b>With Egyptian Sr. Reflectolux Top, Glass Canopy</b>				
351098	353737	353741	351296	15 1 1/2	351121	353737	353736	351342	15 1 1/2
351099	353737	353741	351298	15 1 1/2	351122	353737	353736	351344	15 1 1/2
351100	353737	353741	351299	15 1 1/2	351123	353737	353736	351346	15 1 1/2
351101	353737	353741	351300	15 1 1/2	351124	353737	353736	351347	15 1 1/2
351102	353737	353741	351301	15 1 1/2	351125	353737	353736	351348	15 1 1/2
<b>With Octagonal Sr. Reflectolux Top</b>					<b>With Pagoda Top</b>				
351103	353737	353736	351309	15 4 1/2	351126	353737	353736	351365	15 1
351104	353737	353736	351311	15 4 1/2	351127	353737	353736	351367	15 1
351105	353737	353736	351313	15 4 1/2	351128	353737	353736	351368	15 1
351106	353737	353736	351314	15 4 1/2	351129	353737	353736	351369	15 1
351107	353737	353736	351315	15 4 1/2	351130	353737	353736	351386	15 1
<b>With Octagonal Jr. Reflectolux Top</b>									
351108	353737	353736	351320	15 1 1/2					
351109	353737	353736	351322	15 1 1/2					

Order by Style Number

## CUTTER SINGLE-LIGHT POSTS—Continued

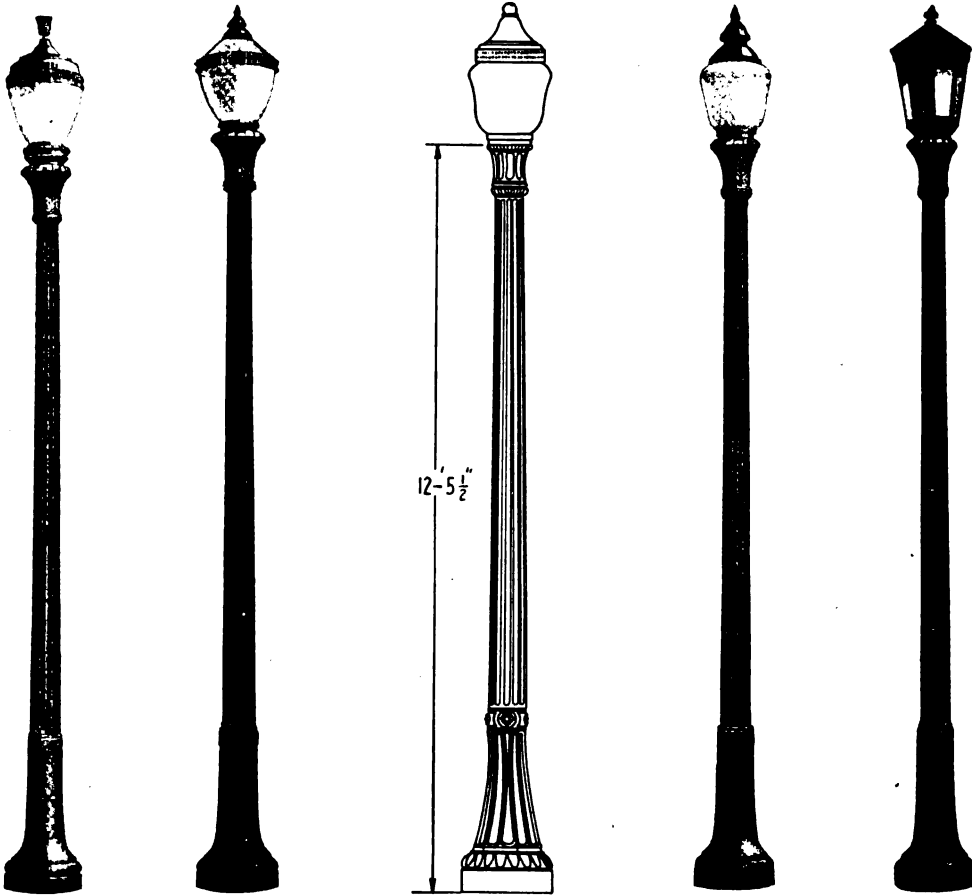
## Grand View Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket.....	351088	662	\$160 00
With Mogul Multiple Socket.....	351089	662	159 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351090	673	188 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351091	674	189 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351092	678	173 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket.....	351093	664	162 00
With Mogul Multiple Socket.....	351094	664	161 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351095	675	170 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351096	676	171 50
With Mogul Socket and Auto-Transformer for 10,000-lumen 20-ampere Lamp.....	351097	680	175 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket.....	351098	666	161 00
With Mogul Multiple Socket.....	351099	666	160 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351100	677	169 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351101	678	170 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351102	682	174 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket.....	351103	754	219 00
With Mogul Multiple Socket.....	351104	754	218 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351105	765	227 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351106	766	228 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351107	770	232 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket.....	351108	689	174 00
With Medium Multiple Socket.....	351109	689	172 80
With Mogul Multiple Socket.....	351110	689	173 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp.....	351111	692	184 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp.....	351112	695	185 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351113	700	182 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351114	701	183 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351115	705	187 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket.....	351116	689	169 00
With Mogul Multiple Socket.....	351117	689	168 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351118	700	177 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351119	701	178 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351120	705	182 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket.....	351121	692	174 00
With Mogul Multiple Socket.....	351122	692	173 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351123	703	182 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351124	704	183 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351125	708	187 00
<b>With Pagoda Top</b>			
With Regent Film Socket.....	351126	764	201 00
With Mogul Multiple Socket.....	351127	764	200 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp.....	351128	775	209 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp.....	351129	776	210 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp.....	351130	780	214 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Vista Posts



STYLE No. 351160

STYLE No. 351141

STYLE No. 351136

STYLE No. 351131

STYLE No. 351152

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Vista Posts as listed on the opposite page are made up of the following combinations.

STYLE NUMBER				Ht. to Light Center Feet Inches	STYLE NUMBER				Ht. to Light Center Feet Inches
Complete Post	Column	Casing	Top		Complete Post	Column	Casing	Top	
<b>With Sol-Lux Senior Top, Metal Canopy</b>					<b>With Octagonal Junior Reflectolux Top—Continued</b>				
351131	353738	353742	351270	12 9 1/2	351154	353738	353743	351323	12 9 1/2
351132	353738	353742	351271	12 9 1/2	351155	353738	353743	351325	12 9 1/2
351133	353738	353742	351272	12 9 1/2	351156	353738	353743	351326	12 9 1/2
351134	353738	353742	351273	12 9 1/2	351157	353738	353743	351327	12 9 1/2
351135	353738	353742	351274	12 9 1/2	351158	353738	353743	351328	12 9 1/2
<b>With Sol-Lux Senior Top, Glass Canopy</b>					351159	353738	353743	351329	12 9 1/2
351136	353738	353742	351276	12 9 1/2	<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>				
351137	353738	353742	351278	12 9 1/2	351160	353738	353743	351335	12 9 1/2
351138	353738	353742	351279	12 9 1/2	351161	353738	353743	351337	12 9 1/2
351139	353738	353742	351280	12 9 1/2	351162	353738	353743	351339	12 9 1/2
351140	353738	353742	351281	12 9 1/2	351163	353738	353743	351340	12 9 1/2
<b>With Meridian Senior Top</b>					351164	353738	353743	351341	12 9 1/2
351141	353738	353742	351296	12 9 1/2	<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>				
351142	353738	353742	351298	12 9 1/2	351165	353738	353743	351342	12 9 1/2
351143	353738	353742	351299	12 9 1/2	351166	353738	353743	351344	12 9 1/2
351144	353738	353742	351300	12 9 1/2	351167	353738	353743	351346	12 9 1/2
351145	353738	353742	351301	12 9 1/2	351168	353738	353743	351347	12 9 1/2
<b>With Octagonal Senior Reflectolux Top</b>					351169	353738	353743	351348	12 9 1/2
351146	353738	353743	351309	13 1/2	<b>With Pagoda Top</b>				
351147	353738	353743	351311	13 1/2	351170	353738	353743	351365	12 9
351148	353738	353743	351313	13 1/2	351171	353738	353743	351367	12 9
351149	353738	353743	351314	13 1/2	351172	353738	353743	351383	12 9
351151	353738	353743	351315	13 1/2	351173	353738	353743	351384	12 9
<b>With Octagonal Junior Reflectolux Top</b>					351174	353738	353743	351385	12 9
351152	353738	353743	351320	12 9 1/2					
351153	353738	353743	351322	12 9 1/2					

Order by Style Number



CUTTER SINGLE-LIGHT POSTS—Continued

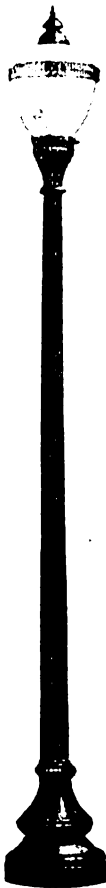
Vista Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket	351131	403	\$110 00
With Mogul Multiple Socket	351132	403	109 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351133	414	118 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351134	415	119 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351135	419	123 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket	351136	405	112 00
With Mogul Multiple Socket	351137	405	111 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351138	416	120 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351139	417	121 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351140	421	125 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket	351141	407	111 00
With Mogul Multiple Socket	351142	407	110 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351143	418	119 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351144	419	120 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351145	423	124 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket	351146	495	169 00
With Mogul Multiple Socket	351147	495	168 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351148	506	177 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351149	507	178 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351151	511	182 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	351152	430	124 00
With Medium Multiple Socket	351153	430	122 90
With Mogul Multiple Socket	351154	430	123 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351155	433	134 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351156	436	135 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351157	441	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351158	442	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351159	446	137 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	351160	430	119 00
With Mogul Multiple Socket	351161	430	118 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351162	441	127 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351163	442	128 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351164	446	132 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	351165	433	124 00
With Mogul Multiple Socket	351166	433	123 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351167	444	132 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351168	445	133 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351169	449	137 00
<b>With Pagoda Top</b>			
With Regent Film Socket	351170	505	151 00
With Mogul Multiple Socket	351171	505	150 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351172	516	159 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351173	517	160 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351174	521	164 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

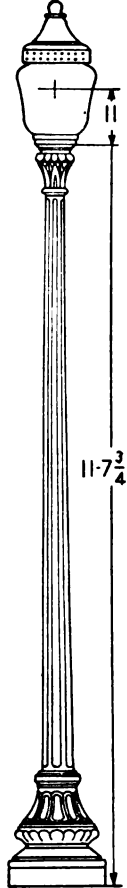
Villa Posts



STYLE No. 351185



STYLE No. 351195



STYLE No. 351183



STYLE No. 351175



STYLE No. 351204

Complete posts are made up in various combinations of three principal parts: column, casing, and post top. Villa Posts as listed on the opposite page are made up in the following combinations.

STYLE NUMBERS				Ht. to Light Center		STYLE NUMBERS				Ht. to Light Center	
Complete Post	Column	Casing	Top	Feet	Inches	Complete Post	Column	Casing	Post Top	Feet	Inches
<b>With Sol-Lux Senior Top, Metal Canopy</b>											
351175	353739	336209	351270	12	4 1/2	<b>With Octagonal Junior Reflectolux Top—Continued</b>					
351176	353739	336208	351271	12	4 1/2	351197	353739	.....	351323	12	4 1/2
351177	353739	336208	351272	12	4 1/2	351198	353739	.....	351325	12	4 1/2
351178	353739	336208	351273	12	4 1/2	351199	353739	.....	351326	12	4 1/2
351179	353739	336208	351274	12	4 1/2	351201	353739	.....	351327	12	4 1/2
<b>With Sol-Lux Senior Top, Glass Canopy</b>											
351180	353739	336208	351276	12	4 1/2	351202	353739	.....	351328	12	4 1/2
351181	353739	336208	351278	12	4 1/2	351203	353739	.....	351329	12	4 1/2
351182	353739	336208	351279	12	4 1/2	<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>					
351183	353739	336208	351280	12	4 1/2	351204	353739	.....	351335	12	4 1/2
351184	353739	336208	351281	12	4 1/2	351205	353739	.....	351337	12	4 1/2
<b>With Meridian Senior Top</b>											
351185	353739	336203	351296	12	4 1/2	351206	353739	.....	351339	12	4 1/2
351186	353739	336203	351298	12	4 1/2	351207	353739	.....	351340	12	4 1/2
351187	353739	336208	351299	12	4 1/2	351208	353739	.....	351341	12	4 1/2
351188	353739	336208	351300	12	4 1/2	<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>					
351189	353739	336208	351301	12	4 1/2	351209	353739	.....	351342	12	4 1/2
<b>With Octagonal Senior Reflectolux Top</b>											
351190	353739	.....	351309	12	4 1/2	351210	353739	.....	351344	12	4 1/2
351191	353739	.....	351311	12	4 1/2	351211	353739	.....	351346	12	4 1/2
351192	353739	.....	351313	12	4 1/2	351212	353739	.....	351347	12	4 1/2
351193	353739	.....	351314	12	4 1/2	351213	353739	.....	351349	12	4 1/2
351194	353739	.....	351315	12	4 1/2	351214	353739	.....	351365	12	4 1/2
<b>With Octagonal Junior Reflectolux Top</b>											
351195	353739	.....	351320	12	4 1/2	<b>With Pagoda Top</b>					
351196	353739	.....	351322	12	4 1/2	351215	353739	.....	351367	12	4
						351216	353739	.....	351383	12	4
						351217	353739	.....	351384	12	4
						351218	353739	.....	351385	12	4

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

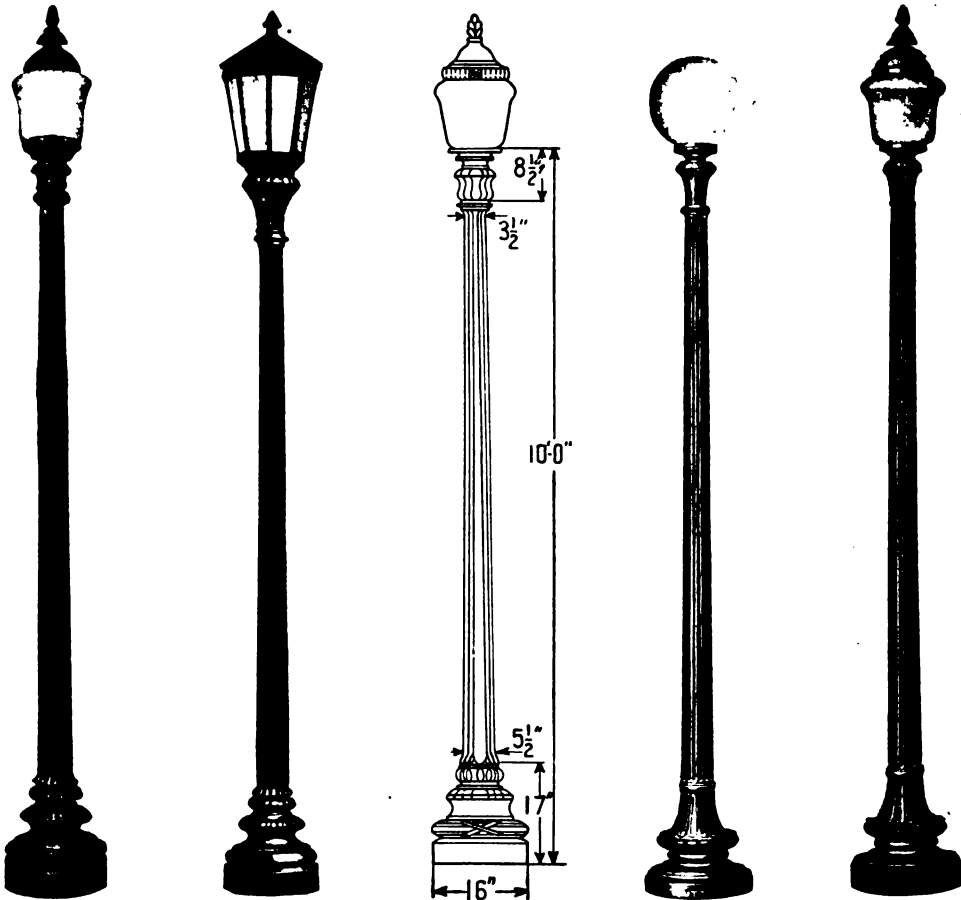
Villa Posts—Continued

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Senior Top, Metal Canopy</b>			
With Regent Film Socket .....	351175	363	\$100 00
With Mogul Multiple Socket .....	351176	363	99 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351177	374	103 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351178	375	109 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351179	379	113 00
<b>With Sol-Lux Senior Top, Glass Canopy</b>			
With Regent Film Socket .....	351180	365	102 00
With Mogul Multiple Socket .....	351181	365	101 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351182	376	110 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351183	377	111 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351184	381	115 00
<b>With Meridian Senior Top</b>			
With Regent Film Socket .....	351185	367	101 00
With Mogul Multiple Socket .....	351186	367	100 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351187	378	109 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351188	379	110 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351189	383	114 00
<b>With Octagonal Senior Reflectolux Top</b>			
With Regent Film Socket .....	351190	455	159 00
With Mogul Multiple Socket .....	351191	455	153 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351192	466	167 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351193	467	168 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351194	471	172 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket .....	351195	390	114 00
With Medium Multiple Socket .....	351196	390	112 90
With Mogul Multiple Socket .....	351197	390	113 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp .....	351193	393	124 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp .....	351199	396	125 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351201	401	122 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351202	402	123 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351203	406	127 00
<b>With Egyptian Senior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket .....	351204	390	109 00
With Mogul Multiple Socket .....	351205	390	108 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351206	401	117 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351207	402	118 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351208	406	122 00
<b>With Egyptian Senior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket .....	351209	393	114 00
With Mogul Multiple Socket .....	351210	393	113 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351211	404	122 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351212	405	123 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351213	409	127 00
<b>With Pagoda Top</b>			
With Regent Film Socket .....	351214	465	141 00
With Mogul Multiple Socket .....	351215	465	140 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp .....	351216	476	149 00
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp .....	351217	477	150 50
With Mogul Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp .....	351218	481	154 00

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Park View and Villa Junior Posts



STYLE No. 341709

STYLE No. 351237

STYLE No. 351222

STYLE No. 351269

STYLE No. 351252

Complete posts are made up in various combinations of three principal parts: column, casing, and top. Park View and Villa Jr. Posts as listed on the opposite page are made up in the following combinations.

Complete Post	STYLE NUMBERS			Ht. to Lt. Ctr. Ft.	In.	Complete Post	STYLE NUMBERS			Ht. to Lt. Ctr. Ft.	In.
	Column	Casing	Top				Column	Casing	Top		
<b>PARK VIEW POSTS</b>											
<b>With Sol-Lux Jr. Top, Metal Canopy</b>											
341709	335747	351380	351282	10	8	351244	335747	336293	351355	10	9
341707	335747	351380	351284	10	8	351245	335747	336293	351356	10	9
341708	335747	351380	351285	10	8	<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
351219	335747	336364	351288	10	8	351246	335747	351381	351357	10	9
351220	335747	336364	351287	10	8	351247	335747	351381	351359	10	9
351221	335747	336364	351288	10	8	351248	335747	351381	351360	10	9
<b>With Sol-Lux Jr. Top, Glass Canopy</b>											
351222	335747	351380	351289	10	8	351249	335747	336293	351362	10	9
351223	335747	351380	351291	10	8	351250	335747	336293	351363	10	9
351224	335747	351380	351292	10	8	351251	335747	336293	351364	10	9
351225	335747	336364	351293	10	8	<b>VILLA Jr. POSTS</b>					
351226	335747	336364	351294	10	8	<b>With 16-inch Ball Globe</b>					
351227	335747	336364	351295	10	8	351267	341096	353781	351387	10	7
<b>With Meridian Jr. Top</b>											
351228	335747	351380	351302	10	8	351268	341096	353781	351388	10	7
351229	335747	351380	351304	10	8	351269	341096	353781	351389	10	7
351230	335747	351380	351305	10	8	<b>With Sol-Lux Jr. Top, Metal Canopy</b>					
351231	335747	336364	351308	10	8	351252	341096	353781	351282	11	10 1/2
351232	335747	336364	351307	10	8	351253	341096	353781	351284	11	10 1/2
351233	335747	336364	351308	10	8	351254	341096	353781	351285	11	10 1/2
<b>With Octagonal Jr. Reflectolux Top</b>											
351234	335747	351381	351320	10	9	<b>With Sol-Lux Jr. Top, Glass Canopy</b>					
351235	335747	351381	351322	10	9	351255	341096	353781	351289	11	10 1/2
351236	335747	351381	351323	10	9	351256	341096	353781	351291	11	10 1/2
351237	335747	336293	351325	10	9	351257	341096	353781	351292	11	10 1/2
351238	335747	336293	351328	10	9	<b>With Meridian Jr. Top</b>					
351239	335747	336293	351327	10	9	351258	341096	353781	351302	11	10 1/2
351378	335747	336293	351328	10	9	351259	341096	353781	351304	11	10 1/2
351379	335747	336293	351329	10	9	351260	341096	353781	351305	11	10 1/2
<b>With Egyptian Jr. Reflectolux Top, Metal Canopy</b>											
351240	335747	351381	351349	10	9	<b>With Egyptian Jr. Reflectolux Top, Glass Canopy</b>					
351241	335747	351381	351351	10	9	351264	341096	353782	351357	10	11
351242	335747	351381	351352	10	9	351265	341096	353782	351359	10	11
351243	335747	336293	351354	10	9	351266	341096	353782	351360	10	11

CUTTER SINGLE-LIGHT POSTS—Continued

Parkview and Villa Junior Posts—Continued

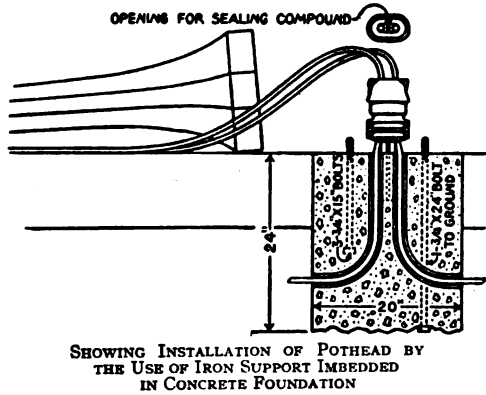
PARK VIEW POSTS

Description	Style No.	Ship. Wt. Lbs.	List Price
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	341709	323	\$83 00
With Medium Multiple Socket	341707	323	81 90
With Mogul Multiple Socket	341708	323	82 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351219	373	95 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351220	376	98 00
With Mogul Socket and Auto-Transformer for 4000-lumen 15-ampere Lamp	351221	381	93 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	351222	325	85 00
With Medium Multiple Socket	351223	325	83 90
With Mogul Multiple Socket	351224	325	84 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351225	375	97 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351226	378	98 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351227	383	95 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	351228	323	84 00
With Medium Multiple Socket	351229	323	82 90
With Mogul Multiple Socket	351230	323	83 00
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351231	373	98 00
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351232	376	97 00
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351233	381	94 00
<b>With Octagonal Junior Reflectolux Top</b>			
With Regent Film Socket	351234	363	101 80
With Medium Multiple Socket	351235	363	100 50
With Mogul Multiple Socket	351236	363	100 80
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351237	366	113 80
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351238	369	114 80
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351239	374	111 80
With Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamp	351378	375	113 10
With Mogul-Socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamp	351379	379	116 80
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	351240	363	94 10
With Medium Multiple Socket	351241	363	93 00
With Mogul Multiple Socket	351242	363	93 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351243	366	108 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351244	369	107 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351245	374	104 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	351246	366	99 10
With Medium Multiple Socket	351247	366	98 00
With Mogul Multiple Socket	351248	366	98 10
With Mogul Socket and Reactance Coil for 1000-lumen, 6.6-ampere Lamp	351249	369	111 10
With Mogul Socket and Reactance Coil for 2500-lumen, 6.6-ampere Lamp	351250	372	112 10
With Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamp	351251	277	109 10
<b>VILLA JUNIOR POSTS</b>			
<b>With 16-inch Ball Globe</b>			
With Regent Film Socket	351267	255	74 85
With Medium Multiple Socket	351268	255	73 75
With Mogul Multiple Socket	351269	255	73 85
<b>With Sol-Lux Junior Top, Metal Canopy</b>			
With Regent Film Socket	351252	252	80 00
With Medium Multiple Socket	351253	252	78 90
With Mogul Multiple Socket	351254	252	79 00
<b>With Sol-Lux Junior Top, Glass Canopy</b>			
With Regent Film Socket	351255	254	82 00
With Medium Multiple Socket	351256	254	80 90
With Mogul Multiple Socket	351257	254	81 00
<b>With Meridian Junior Top</b>			
With Regent Film Socket	351258	252	81 00
With Medium Multiple Socket	351259	252	79 90
With Mogul Multiple Socket	351260	252	80 00
<b>With Egyptian Junior Reflectolux Top, Metal Canopy</b>			
With Regent Film Socket	351261	282	91 10
With Medium Multiple Socket	351262	282	90 00
With Mogul Multiple Socket	351263	282	90 10
<b>With Egyptian Junior Reflectolux Top, Glass Canopy</b>			
With Regent Film Socket	351264	285	96 10
With Medium Multiple Socket	351265	285	95 00
With Mogul Multiple Socket	351266	285	95 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

POST ACCESSORIES  
Potheads



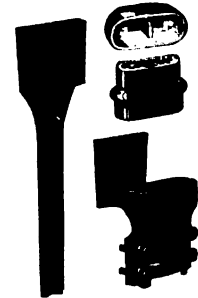
It is necessary to bring the distribution cable above the surface of the ground at each post location and open it for making connections to the inside wiring of the posts. In installations of this kind, static discharges may occur frequently. These will result in ultimately breaking down the insulation, causing interruption of service unless some means is provided to carry the static current to ground.

Such troubles are entirely eliminated by installing a pothead in the base of each post. This device is used for clamping together the lead and steel coverings of the cable and connecting them to ground through the base of the post or the ground support as illustrated. The porcelain body forms a receptacle where the cables are connected and sealed in with insulating compound.

The Cutter Disconnecting Pothead has a two-piece porcelain body so arranged that in the event of breakage of a post the upper part of the pothead is pulled off, thus disconnecting the wires in the post from the underground system, which transmits power at a voltage which would endanger



DISCONNECTING POTHEAD WITH GROUND SUPPORT



PARTS FOR DISCONNECTING POTHEAD

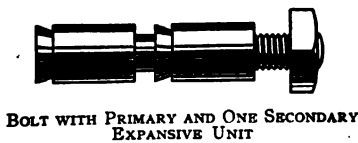
part of the pothead, with the result that the remaining lamps in the system continue in operation.

An iron bracket support should be imbedded in the concrete foundation, and the connections to the cable made before raising the column upon its foundation.

Description	Style No	Wt. Lbs. Each	List Price
Simple Pothead Complete..	342643	16	\$6 00
Consists of Five Parts as follows:			
Simple Pothead Porcelain..	336052	3	1 00
Pothead Body Casting....	336157	5	2 10
2 Clamps.....	336158	1	1 25
Ground Support.....	336127	5	1 50
Sealing compound (1-lb.)..	341911	1	15
Disconnecting Pothead Complete .....	343165	17	12 00
Consists of Five Parts as follows:			
Disconnecting Pothead Porcelain.....	336130	4	7 00
Pothead Body Casting ...	336157	5	2 10
2 Clamps.....	336158	1	1 25
Ground Support .....	336127	5	1 50
Sealing Compound (1 lb.) ..	341911	1	15

Heavy Duty Expansion Bolts

These bolts may be used whenever posts are to be fastened to concrete sidewalks and when brackets are to be mounted on concrete, brick, or stone walls. Their holding power exceeds that of standard machine bolts. They save 50 to 75 per cent of drilling costs. Furnished in sets of four.



BOLT WITH PRIMARY AND ONE SECONDARY EXPANSIVE UNIT



SECTIONAL VIEW SHOWING BOLT WITH PRIMARY EXPANSION SLEEVE, ONE IRON SPACING SLEEVE, AND ONE SECONDARY EXPANSIVE UNIT

Length Inches	Diameter Inches	Style No.	Ship. Wt. Lbs., per 100	List Price per set
4 1/2	3/4	335576	70	\$1 25
6	3/4	335577	80	1 50
9	3/4	335578	90	1 75
12	3/4	335579	100	2 00
4 Spacing sleeves extra		335580	20	20
4 Sec. expansive units		335581	30	90

Foundation Bolts

For foundation bolts see Machine Bolts listed in Section 6-E. Bolts 15-in. long and 3/4-in. diameter are recommended for all posts.

the lives of pedestrians or vehicle drivers coming in contact with them in the event that the post was broken. Also, provision is made for the re-establishment of the circuit through contacts in the lower

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

HAZARD UNDERGROUND CABLES

Modern practice in the installation of ornamental street lighting systems favors the use of steel-armored cable buried in a shallow trench for the carrying of current to the lighting units.

The steel-armored cable consists of a copper conductor insulated with rubber, over which is a braided cover. Next there is a layer of tape, which is enclosed in a continuous lead sheath. A wrapping of steel tape, so arranged as to insure

ample overlapping when the cable is bent, prevents injury to the lead sheath. An outer serving of jute affords protection to the steel tape when placed in the ground. If properly installed, the life of this cable is almost indefinite, as the lead cover forms an efficient protection from water, while the steel armor protects the cable from mechanical injury. Where mechanical protection is not essential, lead covered cable, not encased in steel may be used.



LEAD SHEATHED STEEL ARMORED CABLE

Size B&S	Working Voltage	THICKNESS IN INCHES			Weight in Lbs. per M Feet	List Price per M ft.
		Rubber Wall	Lead Wall	Steel Armor		
<b>Single-Conductor Cable</b>						
8	600	☆	☆	1x.030	847	\$157 00
8	2500	☆	☆	1x.030	1230	214 00
8	3500	☆	☆	1x.030	1390	241 00
8	5000	☆	☆	1x.030	1477	275 00
6	600	☆	☆	1x.030	1175	212 00
6	2500	☆	☆	1x.030	1375	240 00
6	3500	☆	☆	1x.030	1500	268 00
6	5000	☆	☆	1x.030	1680	317 00
<b>Two-Conductor Cable</b>						
8	600	☆	☆	1x.030	1420	263 00
8	2500	☆	☆	1x.030	2050	357 00
8	3500	☆	☆	1x.030	2320	403 00
8	5000	☆	☆	1x.030	2628	491 00
6	600	☆	☆	1x.030	2000	357 00
6	2500	☆	☆	1x.030	2280	410 00
6	3500	☆	☆	1x.030	2540	456 00
6	5000	☆	☆	1x.030	2850	552 00
<b>Three-Conductor Cable</b>						
8	600	☆	☆	1x.030	1985	335 00
8	2500	☆	☆	1½x.030	2660	479 00
8	3500	☆	☆	1½x.030	3100	553 00
8	5000	☆	☆	1½x.030	3600	691 00
6	600	☆	☆	1x.030	2260	437 00
6	2500	☆	☆	1x.030	3000	554 00
6	3500	☆	☆	1½x.030	3460	636 00
6	5000	☆	☆	1½x.030	3950	785 00

LEAD SHEATHED CABLE

Size B&S	Working Voltage	THICKNESS IN INCHES		Weight in lbs. per M Feet	List Price per M ft.
		Rubber Wall	Lead Wall		
<b>Single-Conductor Cable</b>					
8	600	☆	☆	370	\$70 00
8	2500	☆	☆	620	109 00
8	3500	☆	☆	735	128 00
8	5000	☆	☆	810	161 00
6	600	☆	☆	605	112 00
6	2500	☆	☆	710	129 00
6	3500	☆	☆	820	151 00
6	5000	☆	☆	940	192 00
<b>Two-Conductor Cable</b>					
8	600	☆	☆	735	147 00
8	2500	☆	☆	1070	194 00
8	3500	☆	☆	1260	228 00
8	5000	☆	☆	1450	305 00
6	600	☆	☆	1080	201 00
6	2500	☆	☆	1220	234 00
6	3500	☆	☆	1410	271 00
6	5000	☆	☆	1620	351 00
<b>Three-Conductor Cable</b>					
8	600	☆	☆	1210	207 00
8	2500	☆	☆	1660	312 00
8	3500	☆	☆	1970	367 00
8	5000	☆	☆	2320	484 00
6	600	☆	☆	1350	269 00
6	2500	☆	☆	1920	388 00
6	3500	☆	☆	2250	440 00
6	5000	☆	☆	2600	570 00

## CUTTER SINGLE-LIGHT POSTS—Continued

## COLUMNS AND GLOBE HOLDERS

A complete ornamental street-lighting unit consists of a base and a column, preferably cast in one piece, surmounted by the casing or globeholder and the lighting fixture or post top. Auxiliary equipment for the lamps and wiring are necessary detail parts to make the unit complete.

## Ornamental Post

The post should have a base large enough to give stability without occupying excess space on the sidewalk. The column should have gracefully tapering lines so that when cast integral with the base it forms a standard with correct proportions throughout.

Each column is arranged to support the casing at the top. The different designs of posts have different methods of fitting the two together. The various fitters on the top of the column are illustrated on the following page and each of them is designated by a letter. This letter appears in the table below to indicate the type of fitter used at the top of each style of column.

## Casing

The casing, which fits the top of the column, forms both the capitol and the globe holder. It is also arranged to support the insulator, socket, auto-transformer, or reactance coil that is used in the post top.

Casing Fitters are listed on the following page. It will be noted that the type of column top fitter on which each casing may be used is indicated by a letter, as mentioned above. For instance, the Sol-Lux Senior Casing may be used on any column with a type B top fitter. A reference to the table below indicates that the Continental, Continental Medium, Capitol, Capitol Jr., Broadway, Broadway Jr., and Grandview Columns have type B top fitter. Hence the Sol-Lux Senior Casings may be used on any of those columns.

Two methods of supporting the post top are used. The two types of globe holder top fitters are illustrated on the following page. Globes are supported on type G fitters and Reflectolux tops are supported on type A fitters.

However, all casings do not have sufficient space to accommodate auto-transformers or reactance coils. Where such equipment is to be used, the proper casing must be selected as indicated.

## Post Top

The post top consists of the lighting unit together with the insulator and socket or coil. Reflectolux tops are complete with glassware. Sol-Lux and Meridian Tops consist of globe, canopy, holding band, insulator, socket, or coil. **The casing is not considered a part of the post top on the following pages.**

## How to Select Complete Street-Lighting Units

The size and general appearance of a city and the width of the street to be lighted, the average height of abutting buildings, etc., should be considered in the selection of modern street-lighting units. Although the Arcadian and Arcadian Jr. posts are suitable and recommended for nearly all installations, other designs afford selections to suit particular conditions regarding height, size of bases and columns, design, etc.

The following list gives the different styles of columns with principal dimensions, weight and price. The use of the tops recommended for each column insures harmonious combinations and simplifies the selection of the complete unit. The price of a complete unit is the price of the column added to the prices of the casing and top which can be secured from the lists on the following pages. Prices of the most popular combinations of complete posts will be found on preceding pages.

## Columns

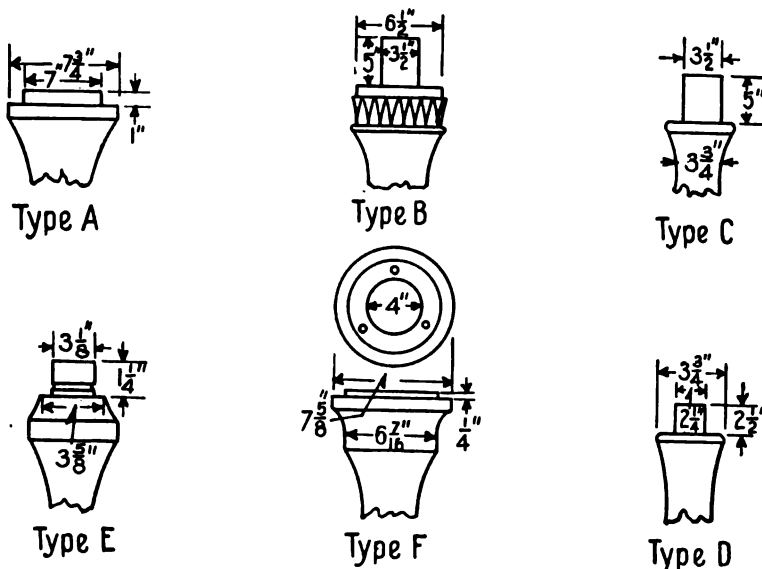
Name of Column	Height of Base and Shaft	Size of Base	Shape of Base	Ht. of Base	Type of Top Fitter	Style No.	Ship Wt. Lbs.	List Price
Arcadian	11 ft. 10 in.	20 in.	Octagonal	....	A	336081	381	\$81 00
Arcadian Jr.	9 ft. 11 in.	16 in.	Octagonal	....	A	336093	239	65 00
Edgewater	11 ft. 10 in.	20 in.	Octagonal	....	..	350379	264	81 00
Edgewater Jr.	9 ft. 8 in.	18 in.	Octagonal	....	E	336529	269	69 00
Commercial	11 ft. 3 in.	21 in.	Octagonal	31 in.	F	339002	467	115 00
Commercial Jr.	9 ft. 9 in.	18 in.	Octagonal	25 in.	F	352987	306	90 00
Continental	11 ft. 4 in.	20 in.	Round	31 in.	B	336009	507	106 00
Continental Medium	10 ft. 4 in.	18 in.	Round	28 in.	B	336311	418	81 00
Continental Jr.	8 ft. 10 in.	16 in.	Round	21 in.	C	336016	246	60 00
Capitol	12 ft. 4 in.	20 in.	Round	31 in.	B	336022	486	106 00
Capitol Jr.	9 ft. 10 in.	18 in.	Round	31 in.	B	336102	431	96 00
Broadway	12 ft. 3 in.	20 in.	Round	33 in.	B	352810	528	106 00
Broadway Jr.	10 ft. 4 in.	20 in.	Round	33 in.	B	335752	448	101 00
Park View	9 ft. 5 in.	16 in.	Round	17 in.	C	335747	243	60 00
Villa	11 ft. 5 in.	19 in.	Round	21 in.	A	351492	310	77 00
Villa Jr.	9 ft. 4 in.	17 in.	Round	18 in.	A	351493	205	61 00
Grand View	12 ft. 8 in.	22 in.	Octagonal	26 in.	B	353737	528	131 00
Vista	12 ft. 6 in.	17 in.	Round	34 in.	F	353738	350	81 00
Boulevard	10 ft. 9 in.	14 in.	Round	34 in.	C	335553	240	59 00
Riverside	11 ft. 1 in.	18 in.	Round	47 in.	C	335542	380	67 00
Commonwealth	11 ft. 5 in.	18 in.	Square	24 in.	C	335794	410	81 00



CUTTER SINGLE-LIGHT POSTS—Continued

COLUMN-TOP FITTERS

The top of each column forms a fitting by means of which either the post top (lighting unit) or the casing may be attached to the column. Drawings of the various types are shown below.



CASING-TOP FITTERS

All casings have top fitters corresponding to the two types shown below. The Globe Ring changes the type A fitter into type G.

Type G-1 casings have the same fitters as type G, but in addition have sufficient space to accommodate reactance coils and auto-transformers.



CASINGS

Name of Casing	Type of Column Top Fitter	Additive Height of Casing Inches	Type of fitter at top of Casing	Style No	Ship. Wt. Lbs.	List Price
Arcadian (with globe ring).....	A	7 1/4	G-1	336152	34	8 00
Arcadian (without globe ring).....	A	5 3/4	A	350662	34	6 00
Edgewater (small, with globe ring).....	E	7	G-1	351383	35	6 00
Edgewater (small, without globe ring).....	E	5	A	353387	35	4 00
Edgewater (large, with globe ring).....	E	7 3/8	G-1	336540	35	8 00
Edgewater (large, without globe ring).....	E	5 3/4	A	351382	35	6 00
Commercial (with globe ring).....	F	7 1/2	G-1	339004	39	8 00
Commercial (without globe ring).....	F	5 1/2	A	353423	39	6 00
*Sol-lux Senior.....	B	14 1/2	G-1	336363	81	8 00
*Sol-lux Junior.....	C	14 1/4	G	336364	80	8 00
Park View (with globe ring).....	C	8 1/4	G	351380	33	6 00
Park View (without globe ring).....	C	6 1/4	A	351381	33	4 00
Egyptian Senior (with globe ring).....	B	12 3/4	G-1	336374	47	8 00
Egyptian Senior (without globe ring).....	B	10 3/4	A	336374	47	6 00
Egyptian Junior (with globe ring).....	C	11 3/4	G-1	336373	40	8 00
Egyptian Junior (without globe ring).....	C	9 3/4	A	336293	40	6 00
Grand View (with globe ring).....	B	19 7/8	G-1	353741	81	8 00
Grand View (without globe ring).....	B	17 7/8	A	353736	81	6 00
Vista (with globe ring).....	F	11	G-1	353742	50	8 00
Vista (without globe ring).....	F	2	A	353743	50	6 00
Globe Ring.....	A	9	G	336208	3	2 00

\*Cannot be furnished without globe holder ring.

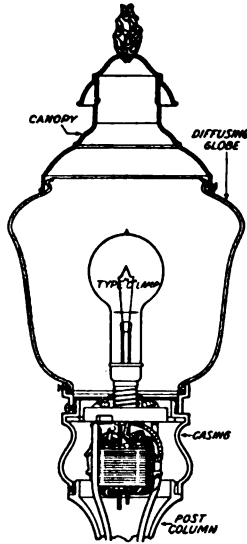
†Each casing can be used only with columns having the type of top fitter indicated in this column.

CUTTER SINGLE-LIGHT POSTS—Continued

SOL-LUX POST TOPS



SOL-LUX POST TOP METAL CANOPY AND ARCADIAN CASING



SECTIONAL VIEW OF SOL-LUX TOP



SOL-LUX POST TOP WITH GLASS CANOPY AND ARCADIAN CASING

Sol-Lux tops are made in two sizes—Senior and Junior—so that a harmonious combination may be obtained with large or small columns. The upper surface of the globe emits sufficient light to properly illuminate building fronts. It is desirable that building fronts should be lighted so as to display their character. However, should all the upward light be allowed to escape, buildings would often be illuminated more than the walks and streets, and electric signs would appear dim as when burning in daylight. With Sol-Lux tops a correct balance in the distribution of light is maintained.

has been carefully developed to meet to the fullest extent the following requirements:

1. To transmit the greater part of the light to sidewalks and streets.
2. To present an artistic contour which affords maximum strength against hail and wind.
3. To conform to the light distribution from the lamp, eliminating shadows, and causing the entire surface to glow with equal intensity.

The result is a pleasing white light without glare, which is the most comfortable and efficient effect.

Porcelain Enamelled Canopy



METAL CANOPY

The canopy must be efficient, easy to clean and the finish of its surface must be durable. It is, therefore, made of steel heavily enamelled with several coats of vitreous porcelain. The standard finish is black outside and white inside; however, when ordered in quantities special finishes can be supplied.

Sol-Lux Globes



SOL-LUX SENIOR GLOBE

The main object of the globe is to conceal the glaring lamp filament. To do this, without a serious absorption of light, requires a glass of peculiar characteristics. Sol-Lux globes are made of glass especially suited for use with the intensely bright Type C lamp. The shape of the Sol-Lux globe

Porcelain Disc Unit Assembly

The Sol-Lux Top is equipped with a heavy porcelain disc shaped to support a multiple or Regent "C" Socket, also auto-transformer or reactance coil. The weight of the wires running from bottom to top of the post is supported from this disc, thus relieving all strain from the binding posts of the socket. The insulation provided by this porcelain disc adds greatly to the safety and reliability in operation.



PORCELAIN DISC INSULATOR WITH AUTO-TRANSFORMER MOGUL SOCKET AND LAMP

Glass Canopy

The canopy is made of the same glass as the Sol-Lux Globe. When used with the filigree holding band, it makes a very attractive appearance. The holding bands lock the canopy securely in place and can be easily removed or replaced.



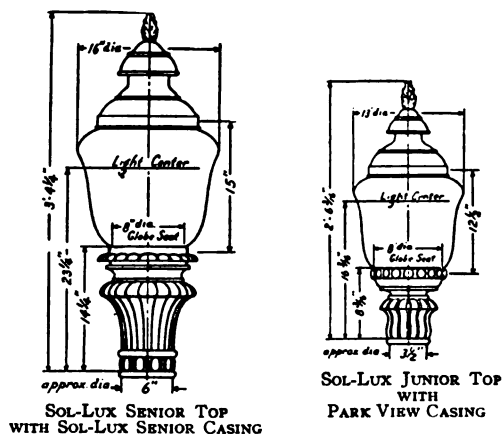
GLASS CANOPY

CUTTER SINGLE-LIGHT POSTS—Continued

Sol-Lux Post Tops—Continued

Sol-Lux ornamental tops are of a most popular design in which the maximum of simplicity and efficiency is combined. The Senior size is suited to large columns where the height to light center is 12 feet or more. The Junior size may be used with any of the smaller columns where the height to light center is less than 12 feet. All Sol-Lux tops are used with type G globe holder fitters, and include globes, filigree holding bands, canopies, disc insulators, sockets, socket holders and coils or auto-transformers. Plain holding bands will be furnished when ordered.

These tops do not include casings. When ordering in casings, refer to Page 913.



Sol-Lux Senior Top, Metal Canopy

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Description	Style No.	Ship. Wt. List	
		Lbs.	Price
Sol-Lux Senior Top, complete with Regent Film Socket	351270	50	\$21 00
Sol-Lux Senior Top, complete with Standard Film Socket	351275	50	21 00
Sol-Lux Senior Top, complete with Mogul Multiple Socket	351271	50	20 00
Sol-Lux Senior Top, complete with Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamps	351272	61	29 00
Sol-Lux Senior Top, complete with Mogul Socket and Auto-Transformer for 6000-lumen, 20-ampere Lamps	351273	62	30 50
Sol-Lux Senior Top, complete with Mogul socket and Auto-Transformer for 10,000-lumen, 20-ampere Lamps	351274	66	34 00

Sol-Lux Senior Top, Glass Canopy

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Sol-Lux Senior Top, complete with Regent Film Socket	351276	52	23 00
Sol-Lux Senior Top, complete with Standard Film Socket	351277	52	23 00
Sol-Lux Senior Top, complete with Mogul Multiple Socket	351278	52	23 00
Sol-Lux Senior Top, complete with Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamps	351279	63	31 00
Sol-Lux Senior Top, complete with Mogul Socket and Auto-Transformer for 6000 lumen, 20 ampere Lamps	351280	64	32 50
Sol-Lux Senior Top, complete with Mogul Socket and Auto-Transformer for 10 000-lumen, 20-ampere Lamps	351281	68	36 00

Sol-Lux Junior Top, Metal Canopy

Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Sol-Lux Junior Top, complete with Regent Film Socket	351282	47	16 40
Sol-Lux Junior Top, complete with Standard Film Socket	351283	47	16 40
Sol-Lux Junior Top, complete with Medium Multiple Socket	351284	47	15 30
Sol-Lux Junior Top, complete with Mogul Multiple Socket	351285	47	15 40
Sol-Lux Junior Top, complete with Mogul Socket and Reactance coil for 1000-lumen, 6.6 ampere Lamps	351286	50	26 40
Sol-Lux Junior Top, complete with Mogul Socket and Reactance coil for 2500-lumen, 6.6 ampere Lamps	351287	53	27 40
Sol-Lux Junior Top, complete with Mogul socket and Auto-Transformer for 4000-lumen, 15-ampere Lamps	351288	58	29 40

Sol-Lux Junior Top, Glass Canopy

Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Sol-Lux Junior Top, complete with Regent Film Socket	351289	49	18 40
Sol-Lux Junior Top, complete with Standard Film Socket	351290	49	18 40
Sol-Lux Junior Top, complete with Medium Multiple Socket	351291	49	17 30
Sol-Lux Junior Top, complete with Mogul Multiple Socket	351292	49	17 40
Sol-Lux Junior Top, with Mogul Socket and Reactance coil for 1000-lumen, 6.6 ampere lamps	351293	52	28 40
Sol-Lux Junior Top, complete with Mogul Socket and Reactance coil for 2500-lumen, 6.6 ampere Lamps	351294	55	29 40
Sol-Lux Junior Top, complete with Mogul Socket and Auto-Transformer for 4000-lumen, 15-ampere Lamps	351295	60	31 40

\*Lamps not included in these prices.

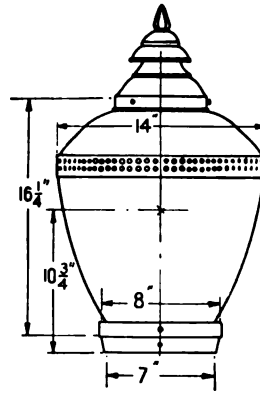
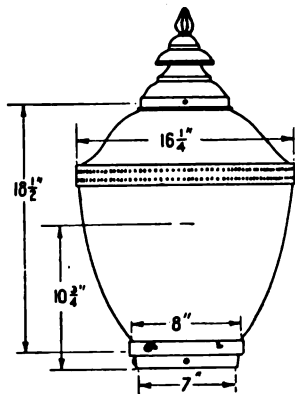
Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

MERIDIAN POST TOPS



MERIDIAN SENIOR POST TOP WITH COMMERCIAL CASING



MERIDIAN JUNIOR POST TOP WITH COMMERCIAL CASING

Meridian tops give approximately the same general lighting results that are obtained from Sol-Lux tops. The globe is made of high efficiency diffuse glass in one piece and the canopy of steel, porcelain enameled, white inside and black outside.

The ornamental band is made of bronze and fits the globe snugly and securely. Sockets are mounted on the disc insulator and reactance coils, or auto-transformers are supported under it as described and illustrated on page 914.

The Senior top is recommended for use with the larger posts where the height to light center is approximately twelve feet.

The Junior top is recommended for the smaller posts and shorter mounting heights.

All tops are used with type G globe holder fitters. Prices include globe, canopy, ornamental band insulator, socket, and auto-transformer or reactance coil as required. Casings are not included. Refer to page 913 when ordering casings.

Meridian Senior Top

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen, Series Type C Lamps\*

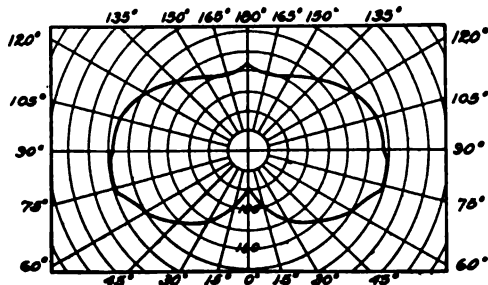
Description	Style No.	Ship. Wt.	List
		Lbs.	Price
Meridian Senior Top complete with Regent film socket.....	351296	54	\$22 00
Meridian Senior Top complete with Standard film socket.....	351297	54	22 00
Meridian Senior Top, complete with mogul multiple socket.....	351298	54	21 00
Meridian Senior Top, complete with mogul socket and auto-transformer for 4000 lumen 15-ampere lamps.....	351299	65	30 00
Meridian Senior Top, complete with mogul socket and auto-transformer for 6000 lumen 20-ampere lamps.....	351300	66	31 50
Meridian Senior Top, with mogul socket and auto-transformer for 10,000 lumen 20-ampere lamps.....	351301	70	35 00

Meridian Junior Top

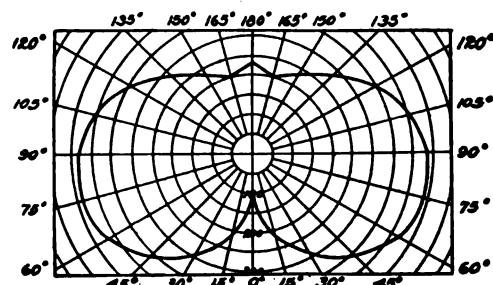
Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Meridian Junior Top, complete with Regent series socket.....	351302	47	17 40
Meridian Junior Top, complete with standard film socket.....	351303	47	17 40
Meridian Junior Top, complete with medium multiple socket.....	351304	47	16 30
Meridian Junior Top, complete with mogul multiple socket.....	351305	47	16 40
Meridian Junior Top, complete with mogul socket and reactance coil for 1000 lumen 6.6-ampere lamps.....	351306	50	27 40
Meridian Junior Top with mogul socket and reactance coil for 2500 lumen 6.6 ampere lamps..	351307	53	28 40
Meridian Junior Top complete with mogul socket and auto-transformer for 4000 lumen 15-ampere lamps.....	351308	58	25 40

\*Prices do not include lamps.



DISTRIBUTION CURVE OF MERIDIAN JUNIOR TOP WITH 250-Cp. TYPE C LAMP



DISTRIBUTION CURVE OF MERIDIAN SENIOR TOP WITH 600-Cp. 20-AMP. TYPE C LAMP

CUTTER SINGLE-LIGHT POSTS—Continued

OCTAGONAL REFLECTOLUX POST TOP



OCTAGONAL JUNIOR REFLECTOLUX TOP



OCTAGONAL REFLECTOLUX PENDENT LANTERN



OCTAGONAL SENIOR REFLECTOLUX TOP

The Reflectolux top is designed to utilize efficiently all of the light given off by the lamp. White porcelain enameled steel reflectors both above and below the lamp redirect the downward and upward rays into useful directions. These reflectors extend to the top and bottom edges of the glass, thus eliminating any possibility of light being trapped in the globe holder or canopy. Their parabolic shape throws the maximum amount of light at an angle of 20° below the horizontal.

The Reflectolux principle is embodied in three different designs, the Octagonal, the Egyptian and the Pagoda. The Beacon top is similar to the Pagoda but is not equipped with glass panels.

The Octagonal Reflectolux and the Pagoda Tops are fitted with panels of sparkling glass, giving the effect of a very large light source, but without excessive glare. The glass panels in the top emit only enough light to bring out the full outline of the lantern.

The Egyptian Reflectolux Top is equipped with a rectilinear globe of slightly opalescent glass, producing the same effect without the panels.

The Octagonal Reflectolux lantern can be supplied in either the upright or the pendent types as shown in the accompanying illustrations. The upright type may be used with any of the standard posts listed on the preceding pages. For the

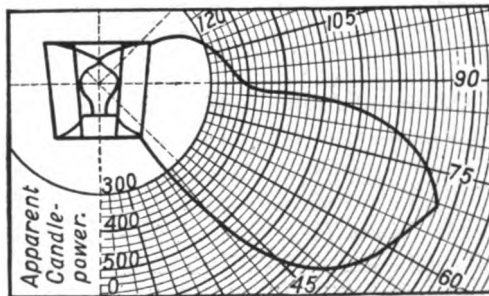
pendent type a supporting arm can be supplied which may be used with the same posts, although it is recommended that columns be used which are high enough to make the distance from the ground to the light center approximately 15 feet.

With the upright type, the top canopy supports the reflector which is above the lamp. This canopy is hinged to facilitate changing lamps, cleaning reflectors and replacing broken panels. For lightness in handling, the canopy is made of aluminum.

In a similar manner the lower casting of the pendent type fixture is made of aluminum and is hinged to swing down and out, carrying with it the lower reflector and making the interior of the fixture accessible for proper maintenance.

The upright type can be furnished with either medium or mogul base sockets for multiple lamps, film sockets for straight series lamps or auto-transformers and mogul sockets for 15 and 20-ampere series lamps. The pendent type does not contain sufficient space for housing an auto-transformer and so can only be furnished with straight series or multiple sockets. These sockets are mounted in the top of the fixture. Lamps for tip down burning should therefore be used.

All Reflectolux Tops are used with type A globe holder or post top fitters.



DISTRIBUTION CURVE OF OCTAGONAL REFLECTOLUX POST TOP WITH 600 CP. TYPE C LAMP

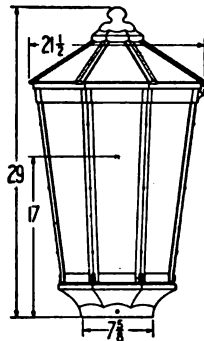
CUTTER SINGLE-LIGHT POSTS—Continued

Octagonal Reflectolux Post Top—Continued

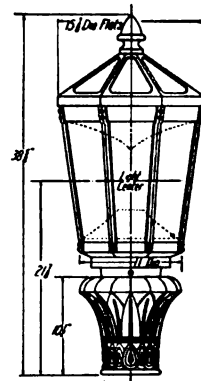
Octagonal Reflectolux tops consist of the frame, glass panels, upper and lower reflectors, socket support, insulator, socket and coil or transformer.

The frame of the Senior top is made of bronze, while the Junior frame is cast iron. Panels of Colonial opal glass are supplied in the Senior top, and Syenite panels in the Junior top. One side panel of the larger top is hinged, giving access to the inside. The Senior top is recommended for use with posts having a fifteen foot mounting height and the Junior top on smaller posts.

Octagonal Reflectolux tops are used on type A Globe Holder Fitters.



OCTAGONAL SENIOR REFLECTOLUX TOP



OCTAGONAL JUNIOR REFLECTOLUX TOP WITH EGYPTIAN SENIOR CASING

Octagonal Senior Reflectolux Top

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Description	Style No.	Ship. Wt. Lbs.	List Price
Octagonal Senior Reflectolux Top, complete with Regent film socket	351309	145	82 00
Octagonal Senior Reflectolux Top, complete with Standard film socket	351310	145	82 00
Octagonal Senior Reflectolux Top, complete with mogul socket for 300 and 500-watt multiple lamps	351311	145	81 00
Octagonal Senior Reflectolux Top, complete with mogul socket for 750 and 1000-watt multiple lamps, and 15 or 20-amp series lamps†	351312	145	81 00
Octagonal Senior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-amp lamps	351313	156	90 00
Octagonal Senior Reflectolux Top, complete with mogul socket and auto-transformer for 6000-lumen 20-amp lamps	351314	157	91 50
Octagonal Senior Reflectolux Top, complete with mogul socket and auto-transformer for 10,000-lumen 20-amp lamps	351315	161	95 00

Octagonal Senior Reflectolux Lantern

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Octagonal Senior Reflectolux Lantern, complete with Regent film socket	351316	145	82 00
Octagonal Senior Reflectolux Lantern, complete with Standard film socket	351317	145	82 00
Octagonal Senior Reflectolux Lantern, complete with mogul socket for 300 and 500-watt multiple lamps	351318	145	81 00
Octagonal Senior Reflectolux Lantern, complete with mogul socket for 750 and 1000-watt multiple lamps and 15 or 20-amp series lamps†	351319	145	81 00

Octagonal Junior Reflectolux Top

Designed for use with 500-Watt or smaller Multiple Lamps and 10,000-Lumen or smaller Series Type C Lamps\*

Octagonal Junior Reflectolux Top, complete with Regent film socket	351320	80	37 00
Octagonal Junior Reflectolux Top, complete with Standard film socket	351321	80	37 00
Octagonal Junior Reflectolux Top, complete with medium multiple socket	351322	80	35 90
Octagonal Junior Reflectolux Top, complete with mogul socket for 300 and 500-watt multiple lamps	351323	80	36 00
Octagonal Junior Reflectolux Top, complete with mogul socket for 750 and 1000-watt multiple lamps, and 15 or 20-amp series lamps†	351324	80	36 00
Octagonal Junior Reflectolux Top, complete with mogul socket and reactance coil for 1000-lumen 6.6-amp lamps	351325	83	47 00
Octagonal Junior Reflectolux Top, complete with mogul socket and reactance coil for 2500-lumen 6.6-amp lamps	351326	86	48 00
Octagonal Junior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-amp lamps	351327	91	45 00
Octagonal Junior Reflectolux Top, complete with mogul socket and auto-transformer for 6000-lumen 20-amp lamps	351328	92	46 50
Octagonal Junior Reflectolux Top, complete with mogul socket and auto-transformer for 10,000-lumen 20-amp lamps	351329	96	50 50

Octagonal Junior Reflectolux Lantern

Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Octagonal Junior Reflectolux Lantern, complete with Regent film socket	351330	80	37 00
Octagonal Junior Reflectolux Lantern, complete with Standard film socket	351331	80	37 00
Octagonal Junior Reflectolux Lantern, complete with medium socket for 200-watt multiple lamps	351332	80	35 90
Octagonal Junior Reflectolux Lantern, complete with mogul socket for 300 and 500-watt multiple lamps	351333	80	36 00
Octagonal Junior Reflectolux Lantern, complete with mogul socket for 750 and 1000-watt multiple lamps and 15 or 20-amp series lamps†	351334	80	36 00

\*Prices do not include lamps.

†When used with safety coils or other external transformers.

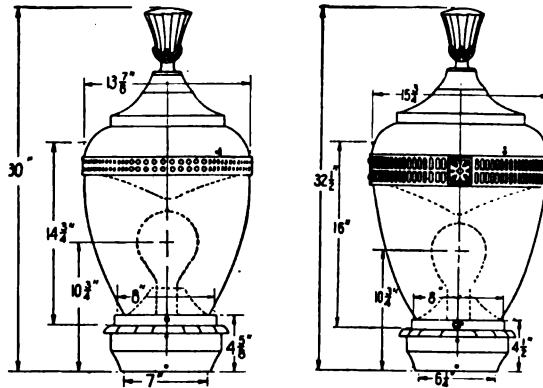
CUTTER SINGLE-LIGHT POSTS—Continued

EGYPTIAN REFLECTOLUX POST TOPS

Used with Type A Globe Holder or Post Fitter



EGYPTIAN JUNIOR REFLECTOLUX TOP



EGYPTIAN SENIOR REFLECTOLUX TOP

Egyptian Senior Reflectolux Top, Metal Canopy

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Description	Style No.	Ship. Wt. Lbs.	List Price
Egyptian Senior Reflectolux Top, complete with Regent film socket.....	351335	80	\$32 00
Egyptian Senior Reflectolux Top, complete with Standard film socket.....	351336	80	32 00
Egyptian Senior Reflectolux Top, complete with mogul socket for 300 and 500 watt multiple lamps.....	351337	80	31 00
Egyptian Senior Reflectolux Top, complete with mogul socket for 750 and 1000 watt multiple lamps, and 15 or 20-ampere series lamps.†.....	351338	80	31 00
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-ampere lamps.....	351339	91	40 00
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 6000-lumen 20-ampere lamps.....	351340	92	41 50
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 10,000-lumen 20-ampere lamps.....	351341	96	45 00

Egyptian Senior Reflectolux Top, Glass Canopy

Designed for use with 300 to 1000-Watt Multiple Lamps and 4000, 6000 and 10,000-Lumen Series Type C Lamps\*

Egyptian Senior Reflectolux Top, complete with Regent film socket.....	351342	83	37 00
Egyptian Senior Reflectolux Top, complete with Standard film socket.....	351343	83	37 00
Egyptian Senior Reflectolux Top, complete with mogul socket for 300 and 500 watt multiple lamps.....	351344	83	36 00
Egyptian Senior Reflectolux Top, complete with mogul socket for 750 and 1000 watt multiple lamps, and 15 or 20-ampere series lamps.†.....	351345	83	36 00
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-ampere lamps.....	351346	94	45 00
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 6000-lumen 20-ampere lamps.....	351347	95	46 50
Egyptian Senior Reflectolux Top, complete with mogul socket and auto-transformer for 10,000-lumen 20-ampere lamps.....	351348	99	50 00

Egyptian Junior Reflectolux Top, Metal Canopy

Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Egyptian Junior Reflectolux Top, complete with Regent film socket.....	351349	80	29 50
Egyptian Junior Reflectolux Top, complete with Standard film socket.....	351350	80	29 50
Egyptian Junior Reflectolux Top, complete with medium socket for 200 watt multiple lamps.....	351351	80	28 40
Egyptian Junior Reflectolux Top, complete with mogul socket for 300 and 500 watt multiple lamps.....	351352	80	28 50
Egyptian Junior Reflectolux Top, complete with mogul socket for 15-ampere series lamps.†.....	351353	80	28 50
Egyptian Junior Reflectolux Top, complete with mogul socket and reactance coil for 1000-lumen 6.6-ampere lamps.....	351354	83	39 50
Egyptian Junior Reflectolux Top, complete with mogul socket and reactance coil for 2500-lumen 6.6-ampere lamps.....	351355	86	40 50
Egyptian Junior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-ampere lamps.....	351356	91	37 50

Egyptian Junior Reflectolux Top, Glass Canopy

Designed for use with 500-Watt or smaller Multiple Lamps and 4000-Lumen or smaller Series Type C Lamps\*

Egyptian Junior Reflectolux Top, complete with Regent socket.....	351357	83	34 50
Egyptian Junior Reflectolux Top, complete with Standard film socket.....	351358	83	34 50
Egyptian Junior Reflectolux Top, complete with medium socket for 200 watt multiple lamps.....	351359	83	33 40
Egyptian Junior Reflectolux Top, complete with mogul socket for 300 and 500 watt lamps.....	351360	83	33 50
Egyptian Junior Reflectolux Top, complete with mogul socket for 15-ampere series lamps.†.....	351361	83	33 50
Egyptian Junior Reflectolux Top, complete with mogul socket and reactance coil for 1000-lumen 6.6-ampere lamps.....	351362	86	44 50
Egyptian Junior Reflectolux Top, complete with mogul socket and reactance coil for 2500-lumen 6.6-ampere lamps.....	351363	89	45 50
Egyptian Junior Reflectolux Top, complete with mogul socket and auto-transformer for 4000-lumen 15-ampere lamps.....	351364	94	42 50

\*Prices do not include lamps.

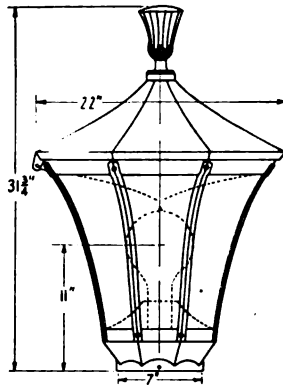
†When used with safety coils or other external transformers.

CUTTER SINGLE-LIGHT POSTS—Continued

PAGODA AND BEACON POST TOPS



PAGODA TOP



BEACON TOP

The Pagoda top is similar to the Octagonal Reflectolux top except that the side panels curve outward.

The Pagoda top consists of the frame, curved glass panels, upper and lower reflectors, socket support, insulator, socket and coil or transformer. The frame is made of cast iron, and the glass panels of vertically ribbed glass. This top is made in only one size and is recommended for use on the larger posts.

The Beacon top is almost the same as the Pagoda top, with the glass panels omitted. However, the

lamp is supported from above instead of below. Bowl enameled lamps are always recommended for use with the Beacon top. This top should be used only with the larger posts.

The complete top consists of frame, upper and lower reflectors, socket, insulator, and socket support. There is not sufficient space in the top to permit the use of reactance coils or auto-transformers. Where the higher candle power lamps are desired, safety coils are mounted in the base of the post.

Both Pagoda and Beacon tops are used on type A globe holder fitters.

Pagoda Top

Designed for use with 300 to 1000 Watt Multiple Lamps and 4000, 6000 and 10,000 Lumen Series Type C Lamps\*

Description	Style No.	Ship. Wt. Lbs.	List Price
Pagoda Top complete with Regent film socket . . . . .	351365	155	84 00
Pagoda Top complete with Standard film socket . . . . .	351366	155	84 00
Pagoda Top complete with mogul socket for 300 and 500 watt multiple lamps . . . . .	351367	155	83 00
Pagoda Top complete with mogul socket for 750 and 1000 watt multiple lamps and 15 or 20-amp. series lamps† . . . . .	351368	155	83 00
Pagoda Top complete with mogul socket and auto-transformer for 4000 lumen, 15 amp. lamps . . . . .	351384	166	72 00
Pagoda Top complete with mogul socket and auto-transformer for 6000 lumen, 20 amp. lamps . . . . .	351385	167	73 50
Pagoda Top complete with mogul socket and auto-transformer for 10,000 lumen, 20 amp. lamps . . . . .	351386	171	77 00

Beacon Top

Designed for use with 300 to 1000 Watt Multiple Lamps and 4000, 6000 and 10,000 Lumen Series Type C Lamps\*

Description	Style No.	Ship. Wt. Lbs.	List Price
Beacon Top complete with Regent film socket . . . . .	351369	127	45 00
Beacon Top complete with Standard film socket . . . . .	351370	127	45 00
Beacon Top complete with mogul socket for 300 and 500 watt multiple lamps . . . . .	351371	127	44 00
Beacon Top complete with mogul socket for 750 and 1000 watt multiple lamps and 15 or 20-amp. series lamps† . . . . .	351372	127	44 00

\*Prices do not include lamps.

†When used with safety coils or other external transformers.

Order by Style Number



CUTTER SINGLE-LIGHT POSTS—Continued

POST TOP PARTS

	Style No.	Ship. Wt. Lbs. Each	List Price
<b>Post Top Globes</b>			
Sol-Lux Senior .....	336150	40	\$12 10
Sol-Lux Junior .....	336148	39	8 10
Meridian Senior .....	336292	45	8 60
Meridian Junior .....	336291	39	8 00
Egyptian Senior Reflectolux (opalescent) .....	353281	45	9 20
Egyptian Senior Reflectolux (clear) .....	352913	45	7 55
Egyptian Junior Reflectolux (opalescent) .....	353282	42	7 40
Egyptian Junior Reflectolux (clear) .....	353223	42	6 25

Monax Ball Globes\*

Diam. of Globe, In.	DIAMETER OF FITTER, INCHES		Style No.	Ship. Wt. Lbs. Each	List Price Per Doz.
	Bottom	Top			
8	6	..	335637	5	\$17 55
9	6	..	335646	6	18 50
10	6	..	335638	7	23 25
12	6	..	335639	8	37 05
12	6	6	335648	8	37 05
12	8	..	335640	8	37 05
14	8	6	335649	14	55 80
14	7	..	335650	14	55 80
14	8	..	335641	14	55 80
16	8	..	335643	18	83 40
16	8	6	335644	18	83 40
18	8	6	335651	26	125 05
20	8	..	335652	36	185 30
12	6	Ruby Glass	335653	8	84 00
14	8	Ruby Glass	335654	14	120 00

Glass Panels

	Style No.	Ship. Wt. Lbs. Each	List Price
Syenite side panel for Octagonal Junior Reflectolux Top .....	353331	5	\$0 60
Syenite top panel for Octagonal Junior Reflectolux Top .....	351373	3	60
Vertically ribbed side panel for Octagonal Junior Reflectolux Top .....	350080	5	30
Vertically ribbed top panel for Octagonal Junior Reflectolux Top .....	351374	3	30
Colonial opal side panel for Octagonal Senior Reflectolux Top .....	353332	6	1 10
Colonial opal door panel for Octagonal Senior Reflectolux Top .....	353403	6	1 10
Colonial opal top panel for Octagonal Senior Reflectolux Top .....	353333	4	50
Syenite side panel for Octagonal Senior Reflectolux Top .....	351375	6	80
Syenite door panel for Octagonal Senior Reflectolux Top .....	351376	6	80
Syenite top panel for Octagonal Senior Reflectolux Top .....	351377	4	80
Curved side panel for Pagoda Top .....	352776	5	70

Canopies

Sol-Lux Senior metal canopy .....	336151	10	5 95
Sol-Lux Senior glass canopy .....	338918	12	9 10
Sol-Lux Junior metal canopy .....	336149	8	5 35
Sol-Lux Junior glass canopy .....	338919	10	7 40
Meridian metal canopy† .....	336211	8	3 90
Egyptian Senior metal canopy .....	353204	25	11 25
Egyptian Junior metal canopy .....	353260	25	8 15
Egyptian glass canopy .....	353407	12	16 25

†Used also on round Ball globes.

Ornamental Top Bands

Plain holding band for Sol-Lux Senior Top .....	336523	2	1 00
Filigree holding band for Sol-Lux Senior Top .....	350788	2	2 00
Plain holding band for Sol-Lux Junior Top .....	336522	2	1 00
Filigree holding band for Sol-Lux Junior Top .....	350790	2	1 35
Meridian Senior band .....	351405	2½	3 80
Meridian Junior band .....	353231	2	2 60
Egyptian Senior band .....	352884	3	3 80
Egyptian Junior band .....	353231	2	2 60

\*Globes of Alba glass will be furnished at same price when so ordered.

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

Post Top Parts—Continued

	Style No.	Ship. Wt. Lbs. Each	List Price
<b>Reflectors for Reflectolux Tops</b>			
Upper reflector for Octagonal Senior Top	351406	6	\$4 50
Lower reflector for Octagonal Senior Top	351407	4	4 10
Upper reflector for Egyptian Senior Top	350095	5	3 40
Lower reflector for Egyptian Senior Top	352922	3	1 50
Upper reflector for Octagonal Junior Top	350095	5	3 40
Lower reflector for Octagonal Junior Top	350094	3	2 40
Upper reflector for Egyptian Junior Top	353271	4	2 65
Lower reflector for Egyptian Junior Top	352922	3	1 50
Upper reflector for Pagoda Top	352793	6	4 15
Lower reflector for Pagoda Top	350094	3	2 40
Upper reflector for Beacon Top	352791	6	3 40
Lower reflector for Beacon Top	350088	5	4 10

Socket Supports for Reflectolux Post Tops

With medium socket for 200 watt multiple lamps	353019	3	2 35
With mogul socket for 300 and 500 watt multiple lamps	352842	3	2 45
With mogul socket for 750 and 1000 watt multiple lamps or 15 and 20 ampere series lamps	353171	3	2 45
With Regent film socket for 2500, 4000, and 6000-lumen straight series lamps	352808	3	3 45
With Standard film socket for 2500, 4000, and 6000-lumen straight series lamps	353238	3	3 45

Socket Supports for Reflectolux Pendent Lanterns

With medium socket for 200 watt multiple lamps	353239	3	2 35
With mogul socket for 300 and 500 watt multiple lamps	352843	3	2 45
With mogul socket for 750 and 1000 watt multiple lamps or 15 and 20-ampere series lamps	352799	3	2 45
With Regent film socket for 2500, 4000, and 6000-lumen straight series lamps	353237	3	3 45
With Standard film socket for 2500, 4000, and 6000-lumen straight series lamps	353238	3	3 45

Sockets

Mogul multiple socket	334751	1 1/4	95
Medium multiple socket	334749	1	85
Regent film socket	337960	1 1/4	1 95
Standard film socket	341135	1 1/2	1 95
1000-lumen reactance unit	351403	7	12 95
2500-lumen reactance unit	351404	10	13 95
4000-lumen auto-transformer unit	335627	11	10 95
6000-lumen auto-transformer unit	335628	12	12 45
10,000-lumen auto-transformer unit	335629	16	15 95

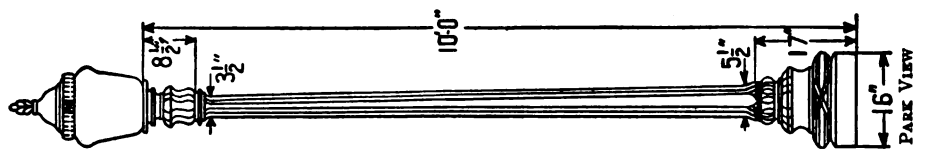
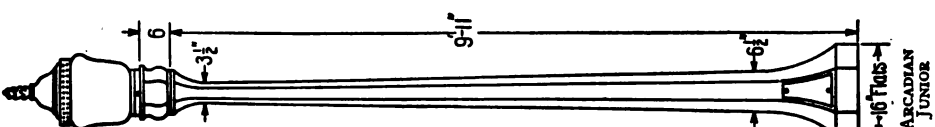
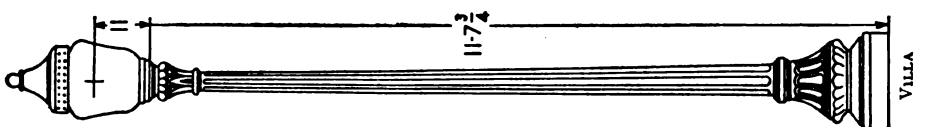
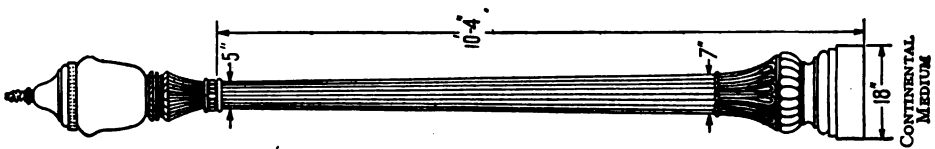
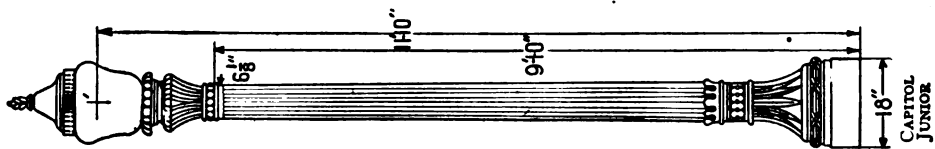
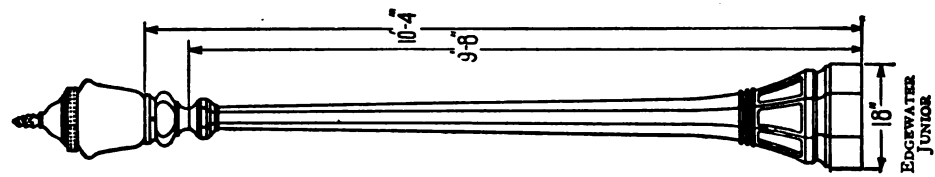
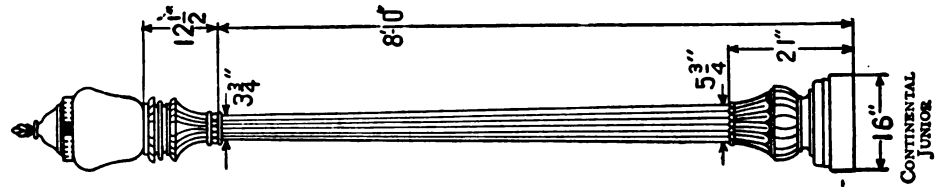
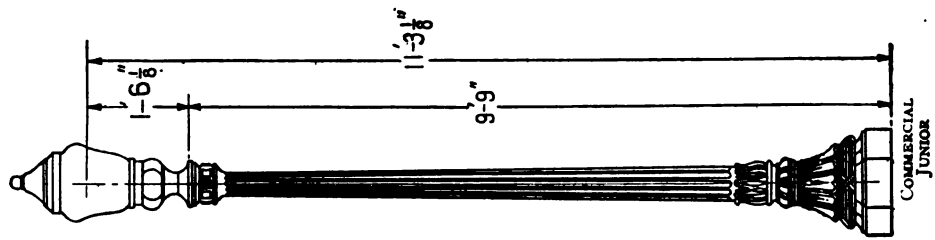
Miscellaneous Parts

Block insulator	336110	1 1/2	35
Porcelain disc insulator	336187	3	1 00
Egyptian Top globe holder assembly	353207	27	5 10

Order by Style Number

CUTTER SINGLE-LIGHT POSTS—Continued

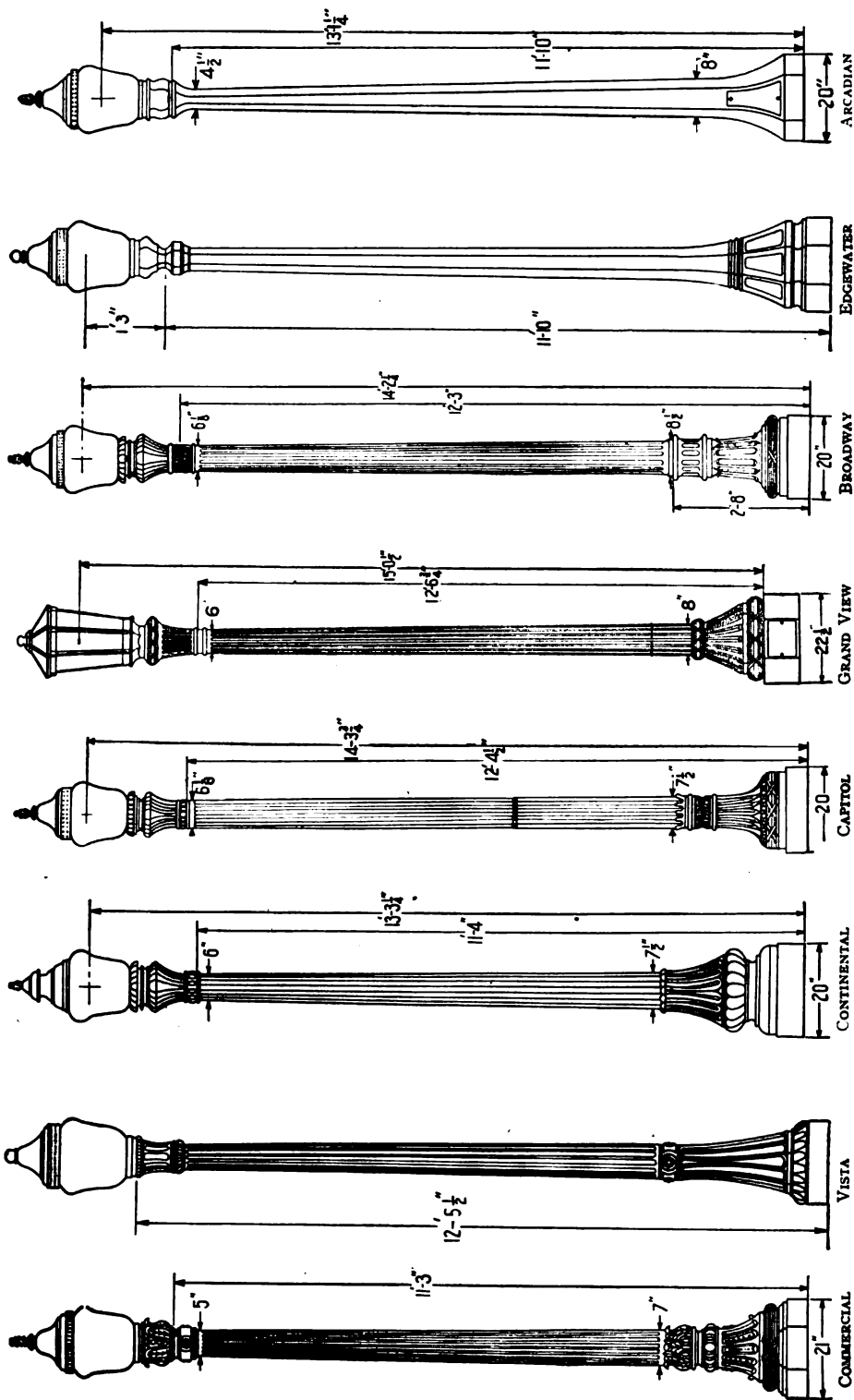
POST DIMENSIONS



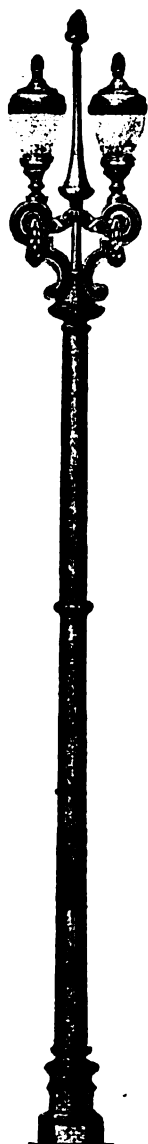
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CUTTER SINGLE-LIGHT POSTS—Continued

POST DIMENSIONS—Continued



## DUPLEX POSTS

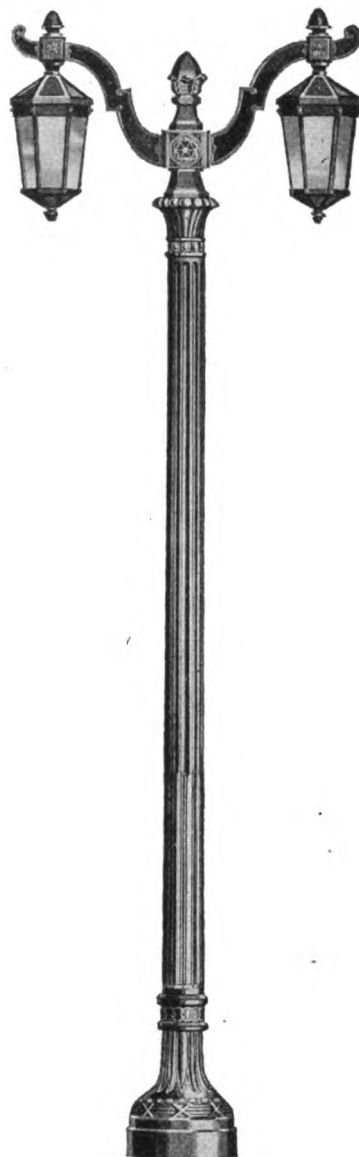


APOLLO POST WITH  
EGYPTIAN REFLECTOLUX  
TOPS

Duplex posts have been designed to meet the growing demand for "Super" whiteway lighting units of high intensity. They are generally installed on exceptionally wide and important business streets and civic centers. The light units are mounted high above the sidewalk and are usually equipped with Reflectolux tops.

Lamps of high candle power may be used with this equipment, as the mounting height of the units keeps the glare above the range of vision of pedestrians and vehicle drivers.

Prices, distribution curves, and complete information will be furnished on request.



SANTIAGO POST WITH  
OCTAGONAL REFLECTOLUX  
PENDANTS

### The Apollo Post

The Apollo post is a new design which with the Egyptian Reflectolux Top makes a very attractive lighting unit. It is especially suitable for use on the main thoroughfares of the larger cities.

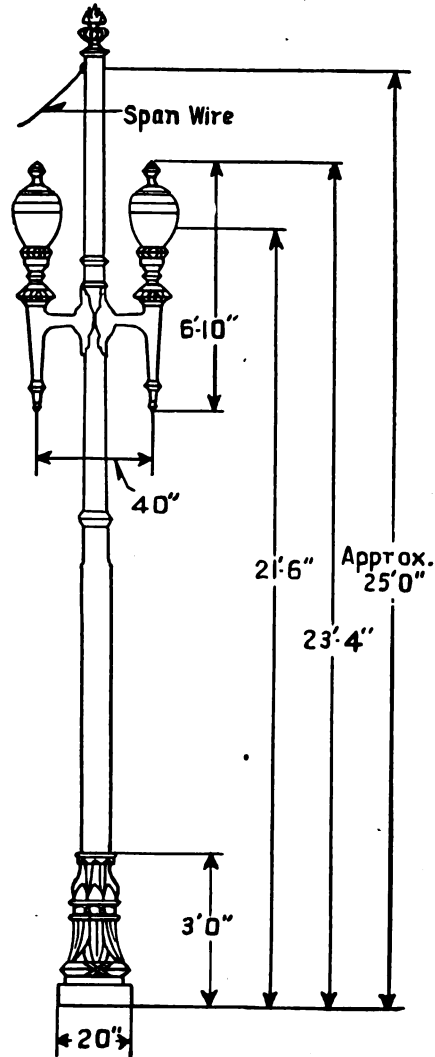
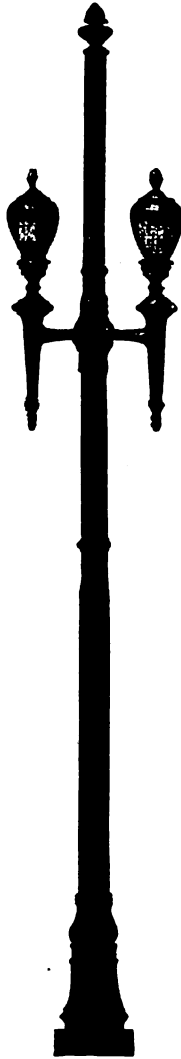
### The Santiago Post

The Santiago post represents a new departure in post construction in that the light units are pendant. This design has many attractive features and the arrangement of the light units produces a very efficient distribution.

7-381B

## TROLLEYLITE BRACKETS

### Columbia Trolleylite Bracket



The treatment of steel poles as ornamental lighting units is a difficult problem. The purely utilitarian steel pole may be given any degree of decoration from a simple bracket which holds the lighting fixture to a casing which entirely covers the pole. Ordinarily an ornamental base and bracket are used.

The base is so designed that it can be slipped over existing trolley poles. The brackets, which may be either single or double arm, are clamped to the poles. These clamps have adjusting bolts which

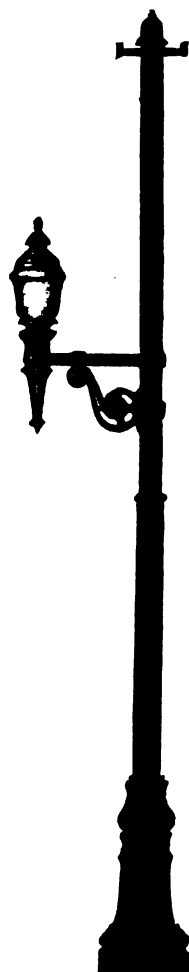
insure perfect alignment of the arm, irrespective of the rake of the pole.

The Columbia Trolleylite bracket has been designed to harmonize with the Egyptian Reflectolux top.

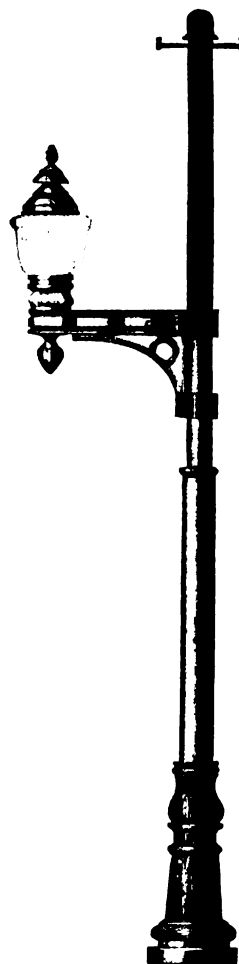
The combination is an efficient and attractive lighting fixture.

Prices, distribution curves, and complete information will be furnished on request.

TROLLEYLITE BRACKETS—Continued



SOL-LUX JUNIOR TROLLEYLITE BRACKET WITH METROPOLIS BASE



MUNICIPAL TROLLEYLITE BRACKET WITH METROPOLIS BASE

**Sol-Lux Junior TrolleyLite Brackets**

The Sol-Lux Junior trolleyLite bracket as listed is a complete fixture, less lamp and wiring, but does not include the steel pole. It is regularly equipped with globe-holder, Sol-Lux Junior globe, metal canopy, porcelain disc insulator and Regent film series socket. Multiple sockets furnished when ordered.\*

Distance from pole to center of globe, 30 inches. Height over all, 52 inches. Diameter of arm, 2 1/4

inches. Distance from center of arm to bottom of scroll, 18 inches.

**Municipal TrolleyLite Brackets**

The Municipal trolleyLite bracket is furnished with globe-holder, Sol-Lux Senior globe metal canopy, porcelain disc insulator and Regent film series socket. Multiple sockets furnished when ordered.\*

Distance from pole to center of globe, 24 inches. Height over all, 53 inches. Width of arm, 4 inches.

**Sol-Lux Junior TrolleyLite Brackets**

	Style No.	Ship. Wt. Lbs.	List Price
For 4-inch Pipe.....	342088	160	\$62 50
For 5-inch Pipe.....	342089	160	62 50
For 6-inch Pipe.....	342090	160	62 50
For 7-inch Pipe.....	342091	160	62 50
For Wooden Poles.....	342985	160	62 50

**Municipal TrolleyLite Brackets**

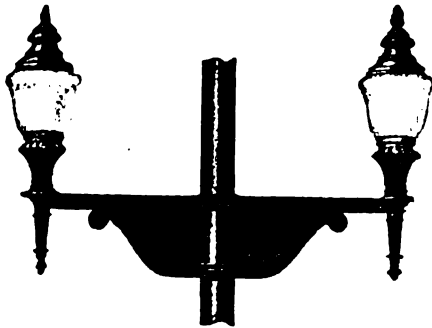
	Style No.	Ship. Wt. Lbs.	List Price
For 4-inch Pipe.....	340967	150	\$80 00
For 5-inch Pipe.....	340968	150	80 00
For 6-inch Pipe.....	340969	150	80 00
For 7-inch Pipe.....	340970	150	80 00
For Wooden Poles.....	340971	150	80 00

\*If mogul multiple socket is used, deduct \$1.00 list for each socket; for medium multiple socket, deduct \$1.10 each list. Prices do not include poles but prices on tubular steel trolley poles will be furnished on request.

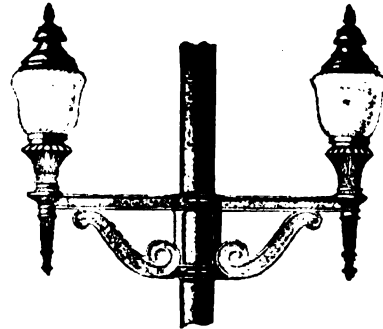
The brackets above can also be furnished as double arm brackets or can be arranged for mounting on expanded metal poles. Prices will be furnished on request.

Order by Style Number

TROLLEYLITE BRACKETS—Continued



AVENUE TROLLEYLITE BRACKET



PARK WAY TROLLEYLITE BRACKET

Avenue Trolleylite Brackets

Furnished in either single or double-arm styles. List prices include globe holders, Sol-Lux Senior globes and ventilators, porcelain disc insulators and Regent film series sockets. If mogul multiple sockets

are used, deduct \$1.00 list for each socket; for medium screw sockets, deduct \$1.20 each list.

Distance from pole to center of globe, 36 inches. Height over all, 57 inches.

Single Arm Brackets

Description	Style No.	Shp. Wt. Lbs.	List Price
For 4-inch pipe	340972	220	\$90 00
For 5-inch pipe	340973	220	90 00
For 6-inch pipe	340974	220	90 00
For 7-inch pipe	340975	220	90 00

Double Arm Brackets

Description	Style No.	Shp. Wt. Lbs.	List Price
For 4-inch pipe	340976	440	\$180 00
For 5-inch pipe	340977	440	180 00
For 6-inch pipe	340978	440	180 00
For 7-inch pipe	340979	440	180 00

Park Way Trolleylite Brackets

Similar to the Avenue trolley bracket listed above, except shorter and lighter. Furnished with Sol-Lux Junior top.

Distance from pole to center of globe, 30 inches. Height over all, 50 inches.

Single Arm Brackets

Description	Style No.	Shp. Wt. Lbs.	List Price
For 4-inch pipe	340980	190	80 00
For 5-inch pipe	340981	190	80 00
For 6-inch pipe	340982	190	80 00
For 7-inch pipe	340983	190	80 00

Double Arm Brackets

Description	Style No.	Shp. Wt. Lbs.	List Price
For 4-inch pipe	340984	380	160 00
For 5-inch pipe	340985	380	160 00
For 6-inch pipe	340986	380	160 00
For 7-inch pipe	340987	380	160 00

Acorn Top Ornaments

A cast iron pole top for use with tubular steel trolley poles.

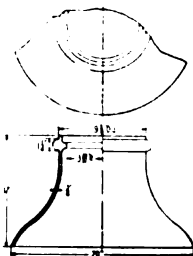


ACORN TOP ORNAMENT

Description	Style No.	Shp. Wt. Lbs.	List Price
For 2 1/4-inch pipe	335603	3	\$2 50
For 3-inch pipe	339608	5	3 00
For 4-inch pipe	339387	8	3 50
For 5-inch pipe	339718	10	4 00
For 6-inch pipe	350015	15	4 50

Plain Wheel Guards

A cast iron base to slip over tubular steel poles to protect the pole from being damaged by the wheels of vehicles.



PLAIN WHEEL GUARD

Description	Style No.	Shp. Wt. Lbs.	List Price
For 6-inch pipe	351398	68	21 00
For 7-inch pipe	351399	68	22 00
For 8-inch pipe	351400	68	23 00

Metropolis Trolley Bases

This base is used in the same way as the Egyptian trolley base.

Description	Style No.	Shp. Wt. Lbs.	List Price
For 5-inch pipe	353172	375	100 00
For 6-inch pipe	335597	385	104 00
For 7-inch pipe	335595	410	108 00
For 8-inch pipe	353173	430	112 00
For 9-inch pipe	335596	450	116 00



METROPOLIS BASE

Order by Style Number



## CLUSTER POSTS

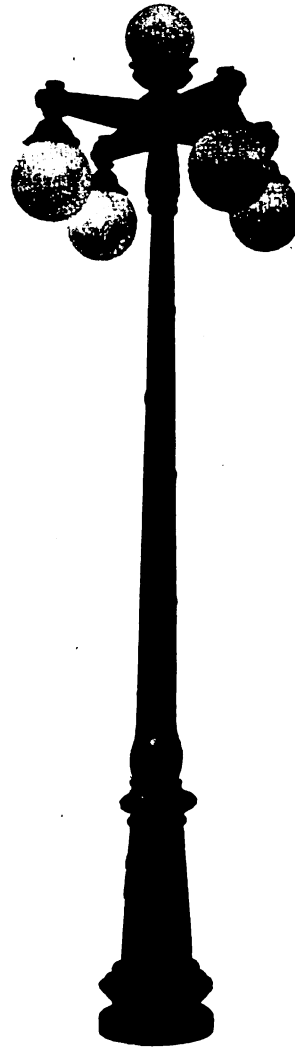
### Broadway and Riverside Posts



BROADWAY

#### Broadway Post

Base, 20 inches in diameter, 2 feet 8 inches high. Column, 7½ inches in diameter above the base, tapering to 6⅛ inches in diameter near the top. Height from ground to bottom of pendent globes, 11 feet 7½ inches; to top of center globe, 15 feet; to top of globe on 1-light post, 14 feet. Distance from center to center of opposite globes, 32 inches. Pendent globes, 6x12 inches; top globe, 8x16 inches. Globe for 1-light post, 8x16 inches. Use four ¾-inch x 15-inch foundation bolts.



RIVERSIDE

#### Riverside Post

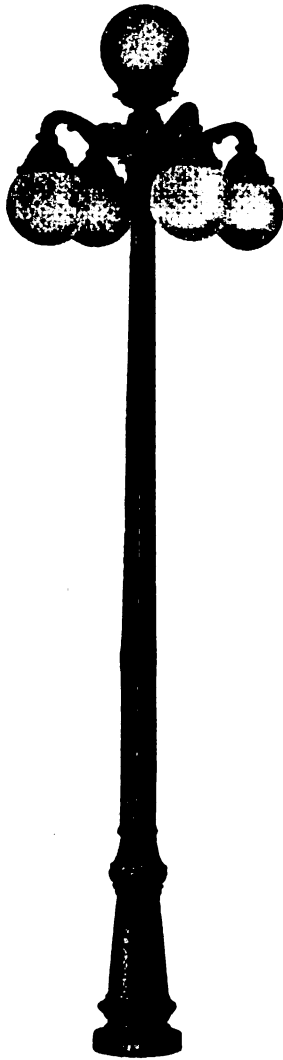
Base, 18 inches in diameter, 3 feet 6 inches high. Column, 8½ inches largest diameter, tapering to 3½ inches in diameter near the top. Height from ground to bottom of pendent globes, 11 feet; to top of top globe, 14 feet; to top of globe on the 1-light post, 13 feet 2 inches. Distance from center to center of opposite globes, 40 inches. All globes 8x12 inches, except for 1-light post, which is 8x16 inches. Use four ¾-inch x 15-inch foundation bolts.

No. of Lights	Style No.	Wt. Lbs. Each	List Price	No. of Lights	Style No.	Wt. Lbs. Each	List Price
1	343180	560	\$96 00	1	340872	450	\$73 00
2	343181	650	118 00	2	340873	500	103 00
3	343182	650	118 00	3	340874	500	103 00
4	343183	700	140 00	4	340875	585	122 00
5	343184	700	140 00	5	340876	585	122 00

Prices of posts include medium screw sockets, but not the globes, wiring, or foundation bolts.

CLUSTER POSTS—Continued

Boulevard and Commonwealth Posts



BOULEVARD

**Boulevard Post**

Base, 14 inches diameter, 2 feet 10 inches high. Column, 5½ inches diameter above the base, tapering to 3½ inches diameter near the top. Height, from ground to bottom of pendent globes, 10 feet; to top of top globe, 13 feet 2 inches; to top of globe on the 1-light post, 12 feet 7 inches. Distance from center to center of opposite globes, 32 inches. Pendent globes, 6x10 inches; top globe, 6x12 inches; globe for 1-light post, 8x14 inches. Use four ¾-inch x 15-inch foundation bolts.



COMMONWEALTH

**Commonwealth Post**

Base, 18 inches square, 2 feet high. Column, 8 inches octagon above the base, tapering to 4 inches octagon near the top. Height from ground to bottom of pendent globes, 11 feet; to top of top globe, 14 feet 3 inches; to top of globe on the 1-light post, 13 feet 6 inches. Distance from center to center of opposite globes, 36 inches. Pendent globes, 6x12 inches; top globe, 8x14 inches; globe for 1-light post, 8x16 inches. Use four ¾-inch x 15-inch foundation bolts.

No. of Lights	Style No.	Wt. Lbs. Each	List Price	No. of Lights	Style No.	Wt. Lbs. Each	List Price
1	340880	300	\$65 00	1	342968	475	\$87 00
2	340881	335	87 00	2	342969	560	118 00
3	340882	335	87 00	3	342970	560	118 00
4	340883	375	100 00	4	342971	665	140 00
5	340884	375	100 00	5	342972	665	140 00

Prices on posts include medium multiple sockets but not the globes, wiring or foundation bolts.

## ORNAMENTAL NEWELS



SOL-LUX 1-LIGHT GATE POST NEWEL

SOL-LUX 5-LIGHT GATE POST NEWEL

SOL-LUX 5-LIGHT BRIDGE NEWEL

SOL-LUX 3-LIGHT BRIDGE NEWEL

SOL-LUX 1-LIGHT BRIDGE NEWEL

### Sol-Lux Gate Post Newels

These newels are made of the highest quality grey iron. They are of distinctive design and very appropriate for the lighting of gateways and private grounds, entrances of buildings, etc.

Base, 14 inches in diameter, 24 inches high. Column, 5 inches in diameter above base, tapering to 3½ inches in diameter near the top. Height from base plane to bottom of side globes, 3 feet 8 inches; to bottom of center globe, 4 feet 6½ inches; to bottom of globe of 1-light newel, 3 feet 8 inches. Distance from center to center of opposite globes, 30 inches. Designed for 6x10-inch side globes, and 6x12 inch top globe.

Prices below include medium screw sockets for side lamps and mogul screw sockets for center lamps, unless otherwise specified. Prices do not include globes, ventilators, lamps, wiring or foundation bolts. Use three 5/8-inch expansion bolts.

No. of Lights	Style No.	Wt. Lbs. Each	List Price
1	340759	125	\$37 50
2	341483	175	70 00
3	341439	175	70 00
4	341440	215	87 50
5	341441	215	87 50

### Sol-Lux Bridge Newels

Similar in design to Sol-Lux gate post newel but higher. Base, 14 inches in diameter, 24 inches high. Column, 5 inches in diameter above the base, tapering to 3½ inches in diameter near the top. Height from base plane to bottom of side globes, 6 feet; to bottom of center globe, 6 feet 10½ inches; to bottom of globe on the 1-light newel, 6 feet. Distance from center to center of opposite globes, 30 inches. Designed for 6 x 10-inch side globes and 6 x 12-inch top globes.

Arms may be reversed for pendent clusters.

Prices below do not include globes, ventilators, lamps, wiring or foundation bolts. Use three 5/8-inch expansion bolts, listed on another page. Prices include medium screw sockets for side lamps and mogul screw sockets for top lamps.

No. of Lights	Style No.	Wt. Lbs. Each	List Price
1	341445	175	\$47 00
2	341446	225	77 00
3	341447	225	77 00
4	341448	265	92 00
5	341449	265	92 00

Order by Style Number

## NEWELS AND TRAFFIC POSTS



SUBURBAN NEWEL



METROPOLITAN NEWEL



"SAFETY FIRST" TRAFFIC POST



COMMERCE NEWEL

### Suburban Newels

Similar to the Arcadian post except smaller. Designed to be used as an ornamental newel or traffic post. Base, 12 inches octagonal. Height to bottom of globe, 6 feet. Uses four 3/4-inch foundation bolts.

Description	Style No.	Ship. Wt. Lbs. Ea.	List Price Each
With 8-in. holder med. mult. socket	340860	187	\$53 90
With 8-in. holder mogul mult. socket	340861	187	54 00
With 8-in. holder Regent film socket	340862	188	55 00
With Sol-Lux Jr. top med. mult. socket	340863	205	70 30
With Sol-Lux Jr. top mogul mult. socket	340864	205	70 40
With Sol-Lux Jr. top Regent film socket	340865	206	71 40

### Metropolitan Newels

A newel of simple but artistic design, adapted for lighting the entrances of buildings or for bridges and public places. Base, 14 inches square, 2 feet high. Column, 5 inches octagonal above the base, tapering to 3 1/2 inches octagonal near the top. Height from base to bottom of globe, 7 feet; Globe holder has 8-inch fitter. Uses four 5/8-inch expansion bolts.

With Oct. Jr. Reflectolux top med. mult. socket	341963	225	89 50
With Oct. Jr. Reflectolux top mogul mult. socket	341964	226	89 60
With Oct. Jr. Reflectolux top Regent film socket	341965	227	90 60
With Sol-lux Jr. top, med. mult. socket	341966	220	78 90
With Sol-lux Jr. top, mogul mult. socket	341967	221	79 00
With Sol-lux Jr. top, Regent film socket	341974	222	80 00

### "Safety First" Traffic Posts

By marking the centers of intersecting streets the rule of "keep to the right" is always enforced. These traffic posts are silent watchmen, always on the job.

Base, 14 inches in diameter, 24 inches high. Column, 5 inches in diameter above the base, tapering to 3 1/2 inches in diameter near the top. Height from base plane to bottom of globe on the 1-light newel, 6 feet. Uses three 3/4 inch foundation bolts.

Prices of above newels do not include globes, lamps, wiring or foundation bolts.

Description	Style No.	Ship. Wt. Lbs.	List Price
6-in. holder med. mult. socket	337935	175	\$46 90
8-in. holder med. mult. socket	337942	176	46 90
6-in. holder mogul mult. socket	341445	176	47 00
8-in. holder mogul mult. socket	337943	177	47 00
6-in. holder Regent film socket	337944	177	48 00
8-in. holder Regent film socket	337945	178	48 00

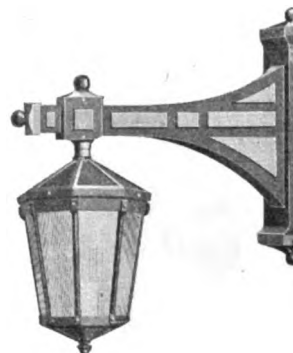
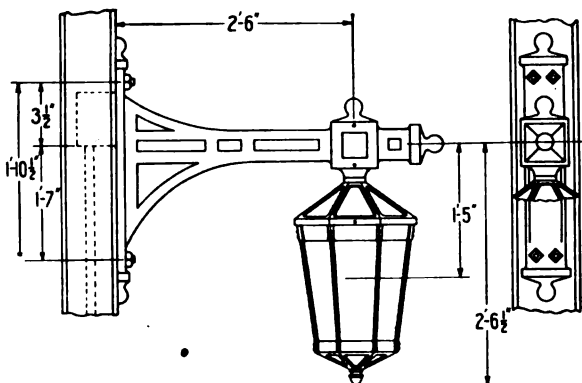
### Commerce Newels

A massive newel designed especially for bridges and entrances to large buildings, etc. Base, 21x35 1/4 inches. Height from ground to bottom of pendent globes, 4 feet 6 inches; to top of eagle ornamentation on top globe, 9 feet 6 inches; to top of eagle ornamentation on 1-light newel, 8 feet. Pendent globes, 8x14 inches; top globe, 8x20 inches; globe for 1-light newel 8x20 inches. Prices below include medium screw base sockets, glassware as above specified and eagle ornamentation, but not foundation bolts. Uses four 5/8-inch expansion bolts.

One-light	353249	475	220 00
Three-light	353250	550	240 00
Five-light	353251	625	270 00

Order by Style Number

## ORNAMENTAL WALL BRACKETS



COLONIAL BRACKET WITH OCTAGONAL JUNIOR REFLECTOLUX PENDANT

### Colonial Bracket

The exterior of churches, public buildings, railroad depots, etc., may be effectively lighted with units mounted on ornamental brackets.

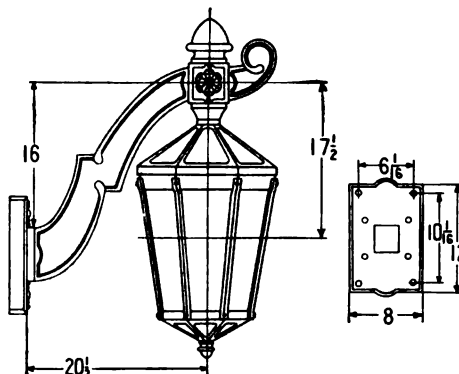
The Colonial Bracket has been designed for use

with Octagonal Reflectolux Lanterns. Price includes the bracket only. See page 917 for prices on lanterns

Style No.	Ship. Wt. Lbs.	List Price
351402	94	\$30 00



SANTIAGO BRACKET WITH OCTAGONAL JUNIOR REFLECTOLUX PENDANT



### Santiago Bracket

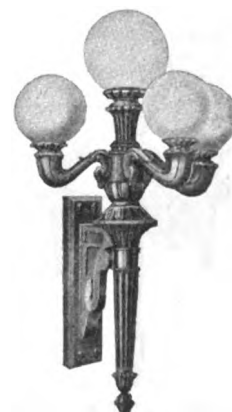
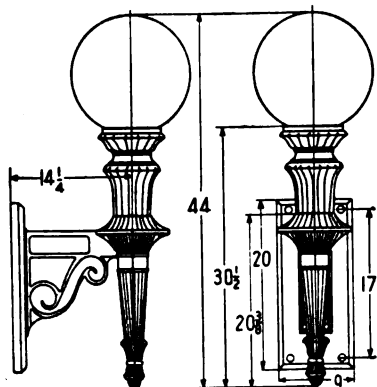
The Santiago Bracket is designed for use with Octagonal Reflectolux Lanterns. Price includes bracket only. See page 917 for price on lanterns.

Style No.	Ship. Wt. Lbs.	List Price
351401	98	\$29 00

### Commerce Bracket

A massive fixture of distinctly artistic and classical design, arranged for Round Ball Globes in one-light, three-light and four-light units. They are particularly adapted for lighting entrances to fine structures.

Prices include bracket with medium screw socket for side globes and mogul screw socket for top globes, but do not include globes; 6x10 globes are recommended for side, and 6x12 for top. See page 921 for prices on globes.



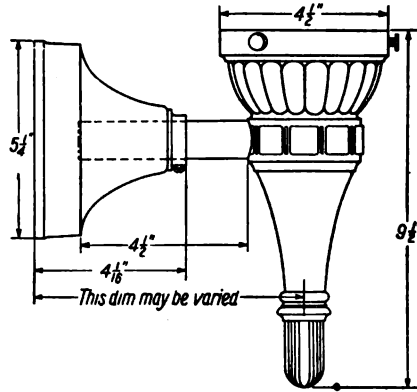
Description	Style No.	Ship. Wt. Lbs.	List Price
One light....	341453	90	\$51 50
Three light..	341454	145	60 00
Four light...	341455	155	65 00

4-LIGHT COMMERCE BRACKET

ORNAMENTAL WALL BRACKETS—Continued



MIDGET BRACKET

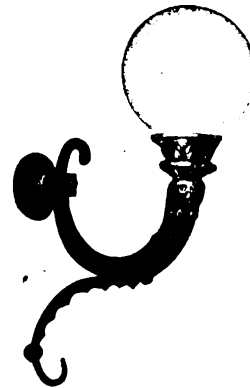
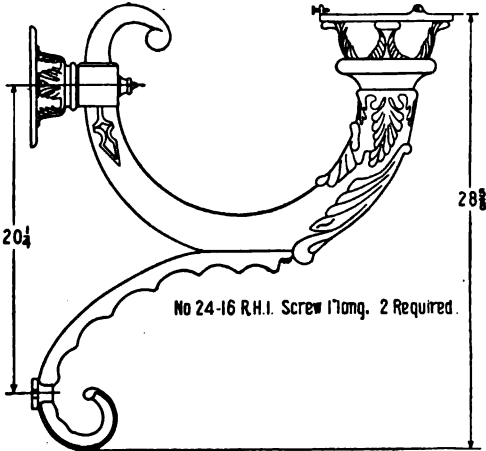


Midget Brackets

A light cast iron bracket designed for small sizes of lamps which do not require ventilation. Has a threaded stem for attachment to crowfoot or con-

duit. Equipped with 4 1/4-inch holder and medium screw socket, but not wired and without globe.

Style No.	Ship. Wt., Lbs.	List Price Each
341451	7	\$5 25



REVERSIBLE BRACKET

Reversible Brackets

When ventilation is not necessary, this bracket may have the globe hang downward. In this position, the bracket has the same artistic lines and correct proportions as in the position illustrated. Fitted with 8-inch globe holder.

Prices do not include globe, ventilator or wiring.

Description	Style No.	Ship. Wt. Lbs.	List Price Each
With medium multiple socket.....	340966	65	\$25 90
With mogul multiple socket.....	341452	65	26 00

Corridor Brackets

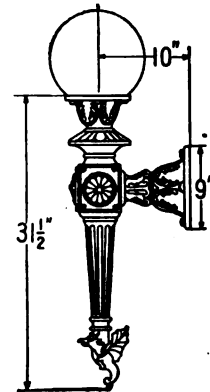
These Cast iron brackets are of artistic design and adaptable to corridors or arcades in office buildings, schools, public buildings, etc.

Prices below include globe holders and medium screw sockets, but not the globes or wiring.



3-LIGHT CORRIDOR BRACKET

Description	Style No.	Ship. Wt. Lbs.	List Price Each
One-light.....	340963	65	\$25 00
Three-light.....	340964	110	27 00
Four-light.....	340965	135	43 50

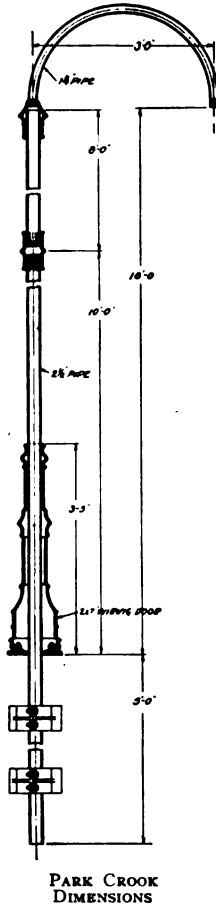
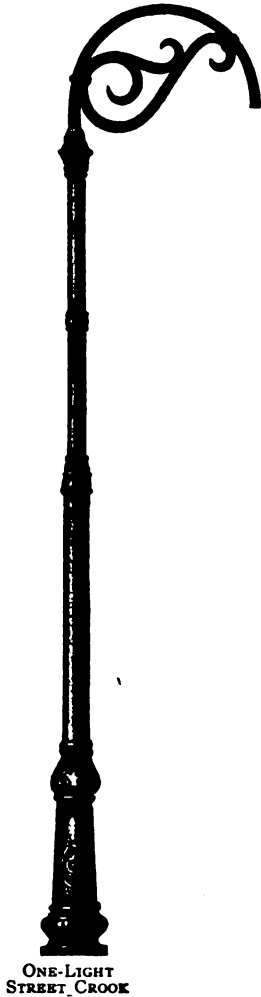


Order by Style Number

7-372A

# CUTTER ORNAMENTAL CROOKS

## Street Crooks and Park Crooks



ONE-LIGHT STREET CROOK

PARK CROOK DIMENSIONS

ONE-LIGHT PARK CROOK

### Street Crooks

These are well built street lighting poles for supporting incandescent lamp fixtures. Height from ground to insulator, 18 feet. Other heights built to order. Diameter of base, 14 inches.

Insulators or 8-inch globe holders with medium screw sockets will be furnished on request. Uses four 3/4x15-inch foundation bolts.

Description	No. of Lights	Style No.	Ship. Wt. Lbs.	List Price
With 1 1/4-inch Pipe Bend only.....	1	340866	455	\$105 00
With 1 1/2-inch Pipe Bend only.....	2	340867	475	110 00

### Park Crooks

Park crooks are light but substantial poles for supporting incandescent lamp fixtures. Standard height from ground to insulator, 18 feet. Other heights built to order. On 14-foot and shorter

heights, 4-foot ground sections will be supplied; on greater heights, 5-foot. If ground section is not wanted, deduct \$7.50 from list and use four 3/4-inch x15-inch foundation bolts.

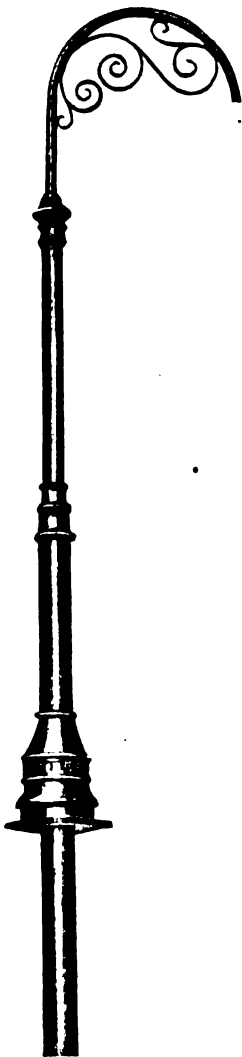
With 1 1/4-inch Pipe Bend only.....	1	340879	335	70 00
With 1 1/2-inch Pipe Bend only.....	2	340895	355	75 00

Order by Style Number

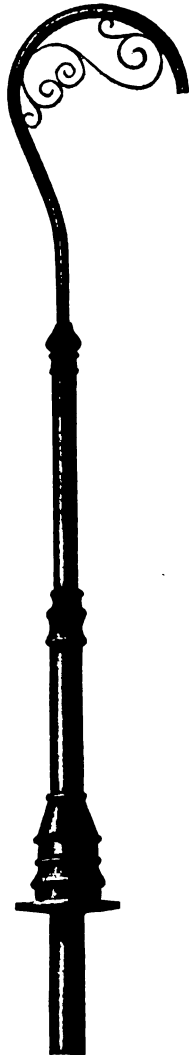
7-373A

CUTTER ORNAMENTAL CROOKS—Continued

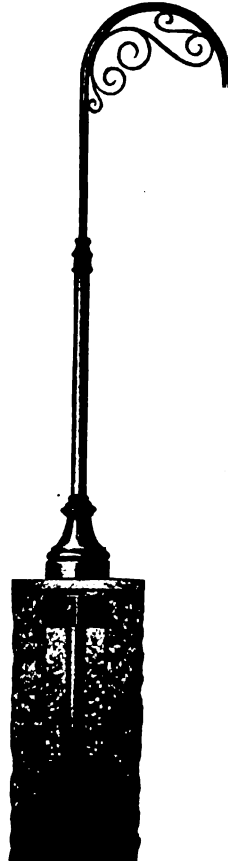
Interurban, Entrance and Platform Crooks



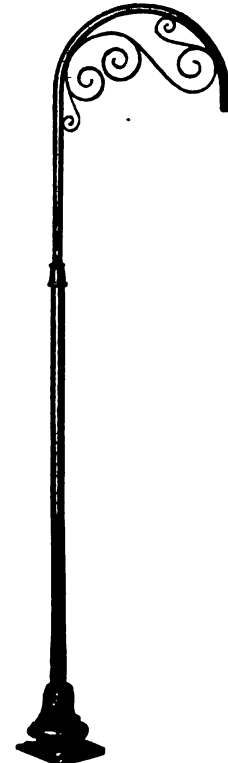
INTERURBAN CROOK



INTERURBAN SWAN NECK



ENTRANCE CROOK



PLATFORM CROOK

Interurban Crooks and Swan Necks

The column is made of 4-inch and 2½-inch pipe, with the 4-inch pipe extending 4 feet into the ground. The cast iron base has a door to make wiring easy. The crook is made of 1¼-inch pipe and holds the lamp 2 feet 3 inches from the column. The height to insulator is 14 feet. High voltage insulator, or 8-inch globe holder with medium screw socket will be furnished when so ordered. If scroll is not wanted, deduct \$2.00 from list. For ground anchors, add \$5.50 to list. If base is not desired, deduct \$5.00 from list price.

Description	Style No.	Wt. Lbs. Each	List Price
Crook with 1¼-inch Pipe Bend only.....	340988	220	\$55 00
Swan Neck with 1¼-inch Pipe Bend only.....	340989	20	45 00

Prices do not include lamps or wiring.

Entrance Crooks

Artistic fixtures for lighting entrances to parks, private grounds, etc. The 2½-inch pipe extends 4 feet into the ground.

Description	Style No.	Wt. Lbs. Each	List Price
With 1¼-inch Pipe Bend only	340992	160	\$45 00

Platform Crooks

A 1¼-inch pipe with cast iron base and crook bend of ½-inch pipe holds the lamp 8 feet from the floor. Prices do not include reflectors.

Description	Style No.	Wt. Lbs. Each	List Price
With ½-inch Pipe Bend only	340994	80	\$18 00

Order by Style Number

7-374A



## ADJUSTER SOCKET TRANSFORMERS

For 2200-Volt 60-Cycle Primary, 6.6-Ampere Secondary

Transformers for other voltages, frequencies and currents can be furnished on order



TRANSFORMER FOR ADJUSTER SOCKET SYSTEM

The adjuster socket system consists of a simple series of lamps connected across the secondary terminals of a constant-potential transformer. A reactance coil is connected in shunt across the terminals of each lamp and operates to maintain the continuity of the circuit and the normal voltage on the remaining lamps in case any lamp burns out or is removed. While it is possible to connect the lamps in series directly across the main, it is always advisable to provide a transformer having taps for a close adjustment of the voltage required.

The transformers listed below are provided with taps to enable any voltage to be obtained within 1 per cent of that required by the circuit. All taps

are brought to terminal blocks inside the transformer case and no soldered connections need be made in changing these taps.

**Regulation**—As the lamps go out and the reactance coils take their place in the circuit, the current will never rise over 2 per cent above normal, this point being reached with from 10 to 15 per cent of the lamps out.

**List price** includes transformer, one set of hanger irons, two fuse blocks (Style No. 29865 or 147190) and the necessary oil.

When ordering, specify separately all the items included in the list price as shown below:

Cap. Kv-a.	SECONDARY VOLTAGE		Gallons Oil	Style No. Hangers	Approx. Shipping Wt., Lbs.	TRANSFORMER	
	Min.	Max.				Style No.	List Price
1	81	151	3/4	109712	106	275188	\$ 85 00
2	170	303	1 1/4	109712	165	275189	110 00
3	252	454	1 3/4	109712	193	275190	130 00
5	416	756	2 1/4	109712	230	275191	160 00
7.5	625	1138	4	109713	315	275192	210 00
10	835	1515	5	109713	394	275193	235 00
15	1250	2270	8	109713	460	275194	290 00
20	1670	3030	14 1/2	234482	715	275195	360 00

### Data on Westinghouse Series Incandescent Lamps

Amps.	Nominal Candle Power	Total Lumens	Average Volts	Average Watts
6.6	60	600	6.7	44.4
6.6	80	800	8.4	55.2
6.6	100	1000	10.0	66.2
6.6	250	2500	22.8	151.0
6.6	400	4000	36.8	242.0
6.6	600	6000	53.5	353.0
15.0	400	4000	14.7	220.0
15.0	600	6000	15.8	316.0
20.0	1000	10000	25.9	518.0
20.0	1500	15000	38.1	761.0
20.0	2500	25000	60.6	1214.0

Order by Style Number

## REACTANCE COIL REGULATOR OUTFITS

For 2200-Volt 60-Cycle Primary; 6.6-Ampere Secondary

Transformers for other voltages, frequencies and currents can be furnished on order

The reactance coil regulator herein described is particularly useful on circuits which are remote from stations where apparatus can be housed. The outfits are especially designed for service where pole mounting and operation with a time switch is desirable. This simplifies the circuit construction and thus reduces the expense of serving outlying towns which may have constant potential feeder service for residence lighting, but for street lighting have nothing available except multiple lamps or long special series circuits from larger existing installations. They are used with the inexpensive and well-known film cutout streethoods, no change being required in these devices.

### Construction

The standard adjuster socket transformers are regularly used with reactance coils to make up these reactance coil regulators. These transformers are thoroughly described under the adjuster socket

system. By reason of their tap arrangement, it is possible to adjust the current to within less than 1 per cent of any required value.

The reactance coils used in connection with this system are separately mounted, thus making it possible to adjust the taps conveniently, and obtain any desired power factor and consequent protection within the range of the apparatus.

### Operation

This system keeps the current in the series lamp circuit from rising abnormally by the use of a reactance in series with the lamp. If one lamp goes out, the impedance of the circuit is diminished by a much lower percentage because of this constant fixed reactance in series with the lamp. Consequently the larger the proportional value of reactance to lamp resistance, the closer will be the regulation with a large percentage of lamps out.

Max. Kw.	Range of Volts	TRANSFORMERS			REACTANCE COILS				Total Shipping Wt., Lbs.	List Price
		Style No.	Style No. Hanger Irons	Gal. Oil	Required Volts	Style No.	Style No. Hanger Irons	Gal. Oil		
<b>Rated on 80% Power Factor</b>										
2.4	252-454	275190	109712	1 1/4	275	240793	.....	.....	310	\$230 00
4.0	416-756	275191	109712	2 1/2	455	240793	.....	.....	346	280 00
6.0	625-1138	275192	109713	4	685	240794	109713	8	665	410 00
8.0	835-1515	275193	109713	5	910	240794	109713	8	744	435 00
12.0	1250-2270	275194	109713	8	1365	246447	109713	11 1/2	990	620 00
16.0	1670-3030	275195	234482	14 1/2	1820	246447	109713	11 1/2	1245	690 00
<b>Rated on 50% Power Factor</b>										
1.5	252-454	275190	109712	1 1/4	395	240793	.....	.....	310	230 00
2.5	416-756	275191	109712	2 1/2	655	240794	109713	8	580	360 00
3.75	625-1138	275192	109713	4	985	240794	109713	8	665	410 00
5.0	835-1515	275193	109713	5	1310	240794	109713	8	744	435 00
7.5	1250-2270	275194	109713	8	1970	246447	109713	11 1/2	990	620 00
10.0	1670-3030	275195	234482	14 1/2	2600	246447	109713	11 1/2	1245	690 00

## REACTANCE COILS

For 60-Cycle 6.6-Ampere Series Film-Cutout Circuits

For use in connection with Adjuster-Socket Transformers listed on a previous page to make up Reactance Coil Regulator Outfits as listed above.

Style number includes reactance coil only. List price includes reactance coil, one pair of hanger irons and the necessary oil. When ordering, specify,

by style number and description, all items included in the list price.

Maximum Kv-a.	Maximum Volts	Gallons Oil	Approx. Shipping Wt., Lbs.	Style No. Hanger Irons	Style No. Coil	List Price
4.0	600	*	116	*	240793	\$100 00
8.5	1290	8	350	109713	240794	200 00
17.2	2600	11 1/2	530	109713	246447	330 00

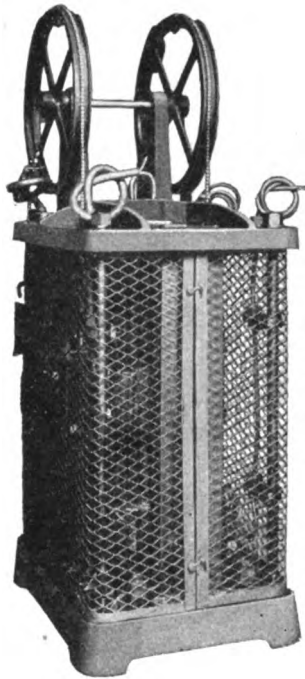
\*Style No. 240793 is gum-filled and is mounted by lag screws—no oil or hanger irons required.

Order by Style Number

## MOVING-COIL REGULATORS AND CONTROL PANELS

### STATION TYPE REGULATORS

The moving-coil regulator depends upon the electrical repulsion existing between the primary and secondary coils of the transformer under load to produce and maintain a constant current in the



secondary or lamp circuit. The regulator can be adjusted to maintain its rated secondary current under the normal conditions of load, primary voltage and frequency, regardless of the number of lamps in the circuit. The coils consist of a number of concentric sections and are known and described as ventilated coils. The individual sections consist of two layers, having one side of each conductor directly exposed to their.

No taping is used except for the protection of leads. The coils are insulated from the metal parts by Micarta tubes. These coils are most rugged and durable, withstanding heavy strains and overloads to the best advantage, and by reason of their light weight, making possible a very high sensitiveness in regulation.

The rating and performance of these regulators is based on average load conditions, consisting of an incandescent load in unity power factor and a line having 5 per cent ohmic and 10 per cent reactive drop. Their rating in kilowatts at the terminals of the regulator with unity power factor would be 9 per cent above the standard rating.

Enclosed carbon arc lamps may be operated from these regulators when equipped with a dash pot. A Westinghouse 6.6-ampere or 7.5-ampere enclosed carbon arc lamp, adjusted in accordance with the specifications, requires .62 or .70 kilovolt-amperes respectively of rated regulator capacity for its operation.

The efficiency of these regulators at full load varies from 90 to 96 per cent for the various sizes. The power factor similarly varies from 83 to 86%.

The regulator will maintain the secondary current within 2 per cent of its normal rating in the

4, 8 and 12-kilowatt sizes, or within 1 per cent on the larger sizes.

**Circuits**—The 34, 50, and 68-kilovolt-ampere sizes are arranged to operate two inter-connected circuits. To keep the load voltage to a minimum, each circuit should be of approximately one-half the capacity of the regulator. Two circuits may be operated from any regulator by the use of a two-circuit panel.

**Taps** — Primary taps are arranged for 2400, 2200 and 2000 volts. Secondary taps are provided for 80 and 90 per cent of full load.

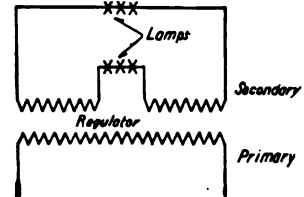


DIAGRAM OF INTER-CONNECTED SECONDARY CIRCUITS

**Automatic operation** with a time switch is successful, if the load is such that the coil separation is not more than 2 inches. With light loads, auxiliary blocks or catches should be installed for reducing the movement of the secondary coil towards the primary coil when the power is interrupted.

### Control Panels

Control panels of black-marine-finished slate mounted on pipe frame work are furnished.

The standard panel for single-circuit, constant-current regulators, is 16 inches by 36 inches and has mounted on it:

(a) One four-pole single-throw type I non-automatic oil circuit-breaker, which, with one operation, connects both the primary and secondary coils to their respective circuits.

(b) One alternating-current high-voltage type SM ammeter.

(c) One double-pole fuse block, (2 single-pole fuse blocks on high-capacity).

(d) Four enclosed fuses (two extra ones) mounted on the back and connected in the primary circuit. Where the working voltage of the regulator to be controlled exceeds 4000 volts, a current transformer (type KA) for the ammeter, which is connected in the secondary circuit, is furnished complete with mounting brackets.

Sub-panels for watthour meters can be supplied for any of the standard panels. These sub-panels are black-marine-finished slate, 16 inches high, mounted on the same frame as the standard panel and directly under it. Apparatus mounted thereon consists of

(a) One type OA watthour meter.

(b) One voltage transformer.

(c) One current transformer.

(d) One double-pole fuse block with four fuses, (two extra) for the voltage transformer.

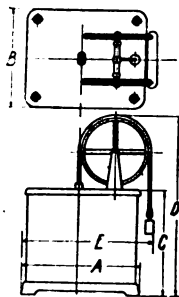
MOVING-COIL REGULATORS AND CONTROL PANELS—Continued

STATION TYPE REGULATORS—Continued  
REGULATING TRANSFORMERS FOR 2200-VOLT 60-CYCLE PRIMARY  
AND 6.6-AMPERE SECONDARY CIRCUITS

Transformers for other voltages, frequencies or currents can be furnished on order

Capacity Kv-a.	APPROX. WEIGHT, LBS.		Style No.	List Price
	Net	Shipping		
4	480	725	200599	\$430 00
8	685	985	200602	500 00
12	850	1200	200605	600 00
17	1000	1350	200608	700 00
24	1250	1650	200611	900 00
34	1350	1750	200614	1050 00
50	1800	2200	238673	1300 00
68	2200	2600	238674	1750 00

For a transformer equipped with dash pot, add \$15.00 to list price.



OUTLINE DIMENSIONS

Moving-Coil Regulators

Kv-a.	25-Cycle		60-Cycle		DIMENSIONS, INCHES				
	A	B	C	D	E	F	G	H	I
4	21 5/8	17	30 1/2	50	29 1/4				
8	23	18	33 3/4	55 1/4	31 5/8				
12	25 1/8	20	35 1/4	55 1/4	32 5/8				
17	26	21	35 3/4	57 3/8	33				
24	28 3/4	26	35 3/4	58	34 1/4				
34	32 1/2	29	34 3/4	55 1/2	36 3/4				
50	34 1/4	30	36 1/4	60	40 1/4				
68	36	32	36 1/4	63 3/4	42				
68	36	32	41 1/8	65 3/4	42				

EFFICIENCY AND POWER FACTOR

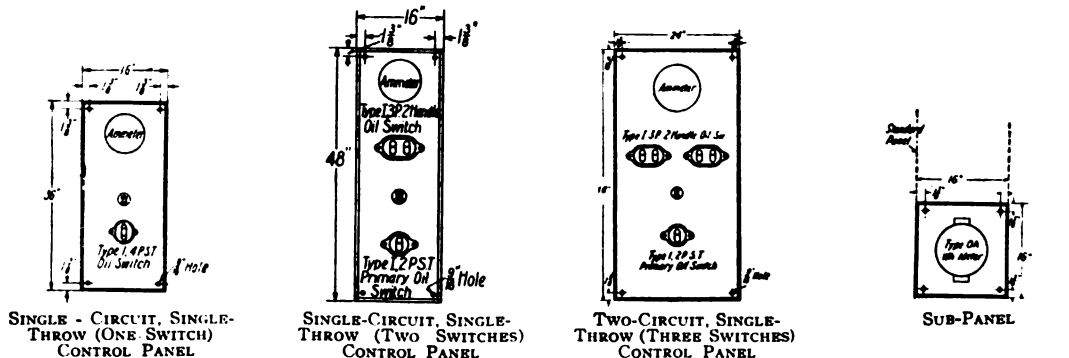
Capacity Kv-a.	Max. Kw.	EFFICIENCY PER CENT			PRIMARY POWER FACTOR PER CENT			
		Full Load	3/4 Load	1/2 Load	Full Load	3/4 Load	1/2 Load	1/4 Load
4	4.21	91.8	90.7	86.7	90.6	85.0	56.7	22.7
8	8.64	93.9	92.9	89.8	91.8	86.0	57.3	23.0
12	12.05	94.1	93.2	90.2	91.1	85.5	57.0	22.0
17	18.15	94.7	93.9	91.1	91.3	85.5	57.0	22.8
24	25.7	95.2	94.5	92.0	91.5	85.8	57.2	22.9
34	35.8	95.5	94.9	92.6	89.9	84.3	56.1	22.0
50	53.2	96.1	95.4	93.4	89.1	83.6	55.6	22.3
68	72.0	96.3	95.7	93.7	90.1	84.5	56.4	22.5

REGULATOR CONTROL PANELS

Description	Style No.	Approx. Ship. Wt., Lbs.	List Price
Single circuit, single throw, (1 switch) Control Panel for 4KVA Regulator	370647	300	\$180 00
Single circuit, single throw, (1 switch) Control Panel for 8KVA Regulator	370648	300	180 00
Single circuit, single throw, (1 switch) Control Panel for 12KVA Regulator	370649	300	180 00
Single circuit, single throw, (1 switch) Control Panel for 17KVA Regulator	370650	300	180 00
Single circuit, single throw, (2 switch) Control Panel for 4KVA Regulator	370651	350	200 00
Single circuit, single throw, (2 switch) Control Panel for 8KVA Regulator	370652	350	200 00
Single circuit, single throw, (2 switch) Control Panel for 12KVA Regulator	370653	350	200 00
Single circuit, single throw, (2 switch) Control Panel for 17KVA Regulator	370654	350	200 00
Single circuit, single throw, (2 switch) Control Panel for 24KVA Regulator	370655	350	200 00
Two circuit, single throw, (3 switch) Control Panel* for 34KVA Regulator	370656	450	300 00
Two circuit, single throw, (3 switch) Control Panel* for 50KVA Regulator	370657	450	300 00
Two circuit, single throw, (3 switch) Control Panel* for 68KVA Regulator	370658	450	300 00

\*Includes current transformer and mounting bracket.

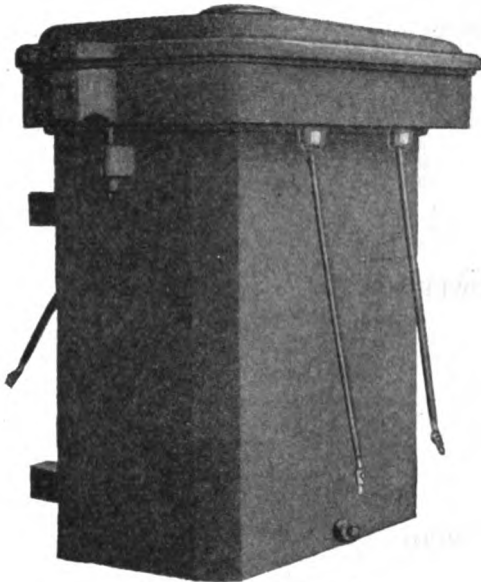
Description	Approx. Ship. Wt., Lbs.	List Price
Sub-panel for any standard panel, complete with necessary watt-hour meter, current, and voltage transformers, fuse blocks, and fuses.	150	\$175 00
Double-throw panels, add to above two-switch and three-switch single-throw panels.	...	50 00
Current transformer and mounting bracket for a panel when operated on regulators of over 4000 volts.	...	30 00



One-Switch Panel is 1 1/4 inches thick and has 1/4-inch bevel; Two-Switch and Three-Switch Panels are 1 1/2 inches thick and have 3/8-inch bevel.  
Width of sub-panel is 16 or 24 inches and thickness 1 1/4 or 1 1/2 inches to match control panel.  
These dimensions are for reference only. For official dimensions apply to the nearest District Office.

## MOVING COIL REGULATORS AND CONTROL PANELS—Continued

## POLE TYPE REGULATORS

MOVING COIL REGULATOR  
POLE TYPE

The great increase in the extent of street lighting systems requiring regulating equipment remote from the central station, has made necessary the Pole-Type Moving-Coil Regulator.

This regulator with its stationary primary coil and movable secondary coil, operates upon exactly the same principle as the station-type of moving-coil regulator. Since it is usually installed in out-of-the-way places, it is necessarily automatic in operation. The working parts are enclosed in a standard transformer case, which is mounted on the pole in the usual manner. Control is effected by means of time switches.

The regulator is designed for a standard primary voltage of 2300 volts, an extra tap being provided for 90 per cent of standard primary voltage. Whenever the voltage falls more than 3 per cent below normal, connections should be made to the 90 per cent tap. Regulators, unless otherwise specified, are furnished with connections made to the standard 2300 volt tap.

The standard secondary current is 6.6 amperes. Regulation is maintained within 1.5 per cent of

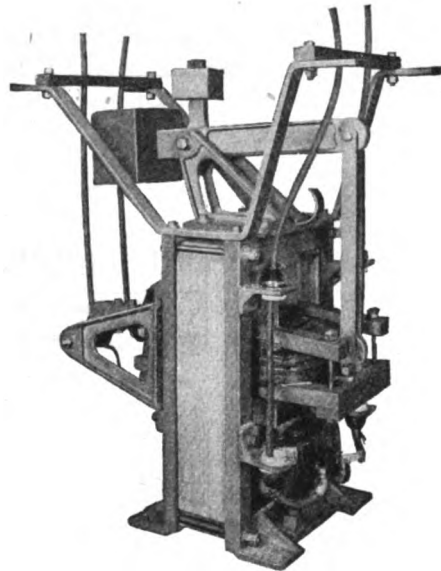
normal, under all load conditions, from full load to short circuit. These regulators have been designed with sufficient margin to take care of 5 per cent line resistance and 10 per cent line reactance.

Two balancing weights are provided, adjustable to a right angle, so that perfect balance is obtained in all positions of the coil. Both weights are entirely above the oil and readily accessible. Set screws with lock nuts are provided to lock the weights securely in position.

Phosphor-bronze bumpers prevent the coils from striking together. Ball bearings are provided at all movable points of support. The movable coil is held securely in a frame of Micarta angles.

**Oil**—Pole Type Regulators must operate in all weathers. To insure satisfactory performance during extremely cold weather Wemco "C" oil is furnished with these regulators and must be used for renewal purposes.

**Lightning protection** is essential on all overhead street lighting circuits. Type LV Autovalve Distribution Arresters are recommended for this application. See Section 1-A.

REGULATOR REMOVED  
FROM CASE

MOVING COIL REGULATORS AND CONTROL PANELS—Continued

POLE TYPE REGULATORS—Continued

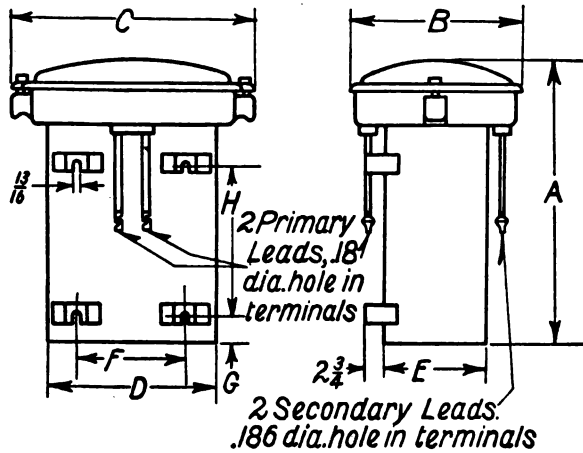
List price includes transformer, one set of hanger irons and the necessary oil.  
When ordering, specify separately each item included in the list price as shown below.

Capacity in kw.	Gallons Oil	APPROXIMATE WEIGHT, LBS. *Net	†Shipping	Style No. Regulator	Style No. Hanger Irons	‡List Price
2	18	405	735	358629	109714	\$415 00
5	18	515	845	358630	109714	520 00
7½	31	600	1070	358631	129384	565 00
10	31	785	1145	358632	129384	580 00
15	58	875	1585	358633	365984	800 00

EFFICIENCY AND POWER FACTOR

Capacity in kw.	EFFICIENCY				PRIMARY POWER FACTOR			
	Full Load	¾ Load	½ Load	¼ Load	Full Load	¾ Load	½ Load	¼ Load
2	91.0	88.3	88.3	71.6	75	55	38	21
5	93.5	91.5	88.3	78.0	75	55	38	21
7½	93.5	91.6	87.8	78.3	75	55	38	21
10	85.7	94.5	92.2	85.5	75	55	38	21
15	95.5	93.8	91.2	83.7	75	55	38	21

DIMENSIONS, INCHES



Capacity in kw.	A	B	C	D	E	F	G	H
2	34½	23½	33½	23½	14½	18	3½	18
5	34½	23½	33½	23½	14½	18	3½	18
7½	39¾	25	35¾	26¼	16¼	20½	3¾	21
10	39¾	25	35¾	26¼	16¼	20½	3¾	21
15	44½	31	39¾	30¼	22¼	24½	3¾	25

\*Net weight includes transformer without oil.  
†Shipping weight includes transformer boxed for shipment, complete with hanger irons and oil in container.  
‡Fuse blocks are not included in this price. (See Style Number Index for Style Nos. 287325 or 147190.)  
§The standard regulator operates on 60-cycle circuits. Regulators for other frequencies can be furnished on order.  
Oil weighs approximately 7 pounds net per gallon and 8½ pounds shipping.  
These dimensions are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number

MOVING COIL REGULATORS AND CONTROL PANELS—Continued

TYPES L AND T TIME SWITCHES

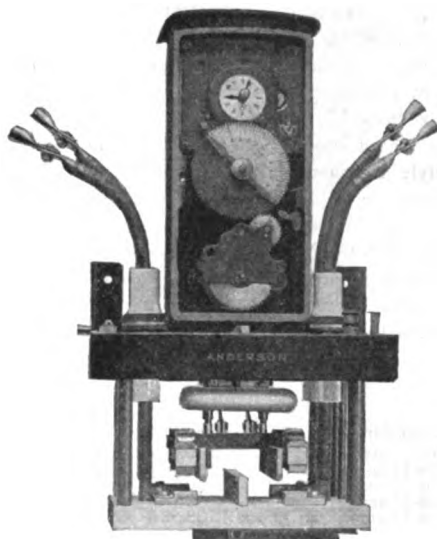
Two or Three-pole, High Tension, Oil Break

Type L Time Switch

This type of switch is constructed for controlling alternating-current circuits up to, and including, 6600 volts, and is furnished either two or three-pole. It is an oil-break switch having a high grade propelling mechanism and time piece.

This apparatus is used extensively in connection with the pole-type, constant-current regulator, where lamps are connected permanently to the secondary coil of the regulator.

When these switches are installed on poles, or other exposed places, additional weather protection should be provided. For this purpose a wooden housing with porcelain insulators can be supplied at \$16.00 list price, additional.



TYPE L TIME SWITCH

Type T Time Switch

This type of switch is similar to type L, except that it is electrically wound. Switches are furnished for winding at either 110 or 220 volts, alternating current or direct current. Orders should state the winding voltage and, if alternating current, the frequency of the circuit.

If desired, these switches can be furnished at \$40.00 list price, additional, with an attachment which automatically takes care of seasonal variation in the day's length.

LIST PRICES

Style numbers and list prices cover complete apparatus, including oil chamber and sufficient oil to fill to the working level.

TYPE L SWITCHES

For Potentials Not Exceeding 3300 Volts

Style No.	Capacity Amperes	Number of Poles	DIMENSIONS IN INCHES			APPROX. Net	Wt. Lbs. Shipping	List Price
			Length	Width	Depth			
W-11039	25	2	20	10½	7¼	44	65	\$120 00
W-11040	50	2	20	10½	7¼	45	65	130 00
W-11043	25	3	20	14	10	50	75	144 00
W-11044	50	3	20	14	10	50	75	160 00

For Potentials Not Exceeding 6600 Volts

W-11080	25	2	20	11½	8	50	75	200 00
W-11081	50	2	20	11½	8	50	75	220 00
W-11084	25	3	21	15	10	60	90	240 00
W-11085	50	3	21	15	10	60	90	270 00

TYPE T SWITCHES

For Potentials Not Exceeding 3300 Volts

Style No.	Capacity Amperes	Number of Poles	DIMENSIONS IN INCHES			APPROX. Net	Wt. Lbs. Shipping	List Price
			Length	Width	Depth			
W-11098	25	2	22	10½	7¼	65	90	\$200 00
W-11099	50	2	22	10½	7¼	65	90	210 00
W-11100	25	3	22	14	10	70	95	224 00
W-11101	50	3	22	14	10	70	95	240 00

For Potentials Not Exceeding 6600 Volts

W-11102	25	2	22	11½	8	70	100	280 00
W-11103	50	2	22	11½	8	70	100	300 00
W-11104	25	3	22	15	10	80	110	320 00
W-11105	50	3	22	15	10	80	110	350 00

Types L and T switches operate in primary circuits only. If desired, type M switches, which operate in both primary and secondary circuits, can be supplied. Prices will be furnished on request.

Order by Style Number

## AUTO-TRANSFORMERS

The demand for increased efficiencies in lighting systems led the lamp manufacturers to produce series lamps, which operate at 15 and 20 amperes. In order that these lamps might be operated on standardized series circuits of 6.6 or 7.5 amperes, auto-transformers were designed for use with each lamp. The current is taken from the line at either 6.6 or 7.5 amperes and delivered to the lamp at 15 amperes for 4000 lumen lamps and 20 amperes for 6000 and 10000 lumen lamps. Mogul base multiple sockets should be used.

In some localities, it has been found desirable to distribute power on low voltage multiple circuits and at the same time make use of the high current series lamps. The 6000 lumen 110 and 220-volt multiple coils listed below make this possible. They may be connected on 110 or 220-volt mains and by the selection of the proper tap, will deliver 15 or 20

amperes to the 4000 and 6000 lumen series lamp. This application, however, has certain disadvantages in that the series lamps are not regularly selected for uniformity in voltage and unless careful tests are made to determine the proper tap on the coil for each lamp there is a possibility of considerable variation in lamp current, resulting in low efficiency or short life. However, where lamps have been especially selected for this purpose, satisfactory results have been obtained.

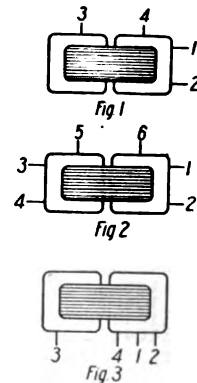
**Style number and list price** include bare coil without socket or mounting details. Series coils have taps for either 6.6 or 7.5-ampere line current and each coil has a tap for the next smaller lamp as well as the lamp for which it is rated. Coils are for 60 cycles. Prices for special frequencies will be furnished on request.

Lamp Lumens	Approx. Watts	Primary	Secondary	Style No.	List Price
4000	200	6.6-7.5 amps.	15 amps.	250220	\$ 8 00
6000-4000	300	6.6-7.5 amps.	20-15 amps.	250221	10 25
10000-6000	500	6.6-7.5 amps.	20 amps.	250222	13 75
6000-4000	300	110 volts	20-15 amps.	302535	12 50
6000-4000	300	220 volts	20-15 amps.	302536	12 50

### DIAGRAMS OF CONNECTIONS FOR AUTO-TRANSFORMERS

Style No.	Fig. No.	Lamp Lumens	Line Current	Lamp Current	CONNECTIONS	
					Line	Lamp
250220	1	4000	6.6	15	1, 4	3, 4
250220	1	4000	7.5	15	2, 4	3, 4
250221	2	6000	6.6	20	1, 6	5, 6
250221	2	6000	7.5	20	2, 6	5, 6
250221	2	4000	6.6	15	3, 6	5, 6
250221	2	4000	7.5	15	4, 6	5, 6
250222	2	10000	6.6	20	1, 6	5, 6
250222	2	10000	7.5	20	2, 6	5, 6
250222	2	6000	6.6	20	3, 6	5, 6
250222	2	6000	7.5	20	4, 6	5, 6

Diagrams for Style Nos. 302535 and 302536 will be furnished on request.



### REACTANCE COILS

The single-phase reactance coils listed below are mounted in streethoods and post tops when an adjuster socket system is used to maintain constant current. The style numbers given are for 6.6 am-

peres 60-cycle coils, without sockets or mounting details. Prices for complete fixtures are given on other pages.

Lamp Lumens	Style No.	List Price
320-400-600	219180	\$ 8 00
800-1000	219181	9 00
2500	262293	11 00
4000	262294	13 00

*Order by Style Number*



## SAFETY COILS

### For Indoor and Outdoor Service on Series A-C. Circuits



FIG. 1—REAR VIEW OF TYPE SK (OIL-INSULATED-TYPE) SHOWING METHOD OF ATTACHING HANGER IRONS



FIG. 2—TYPE MA (DRY-TYPE) ( $\frac{1}{2}$  AND 1 KV-A)

It is often desirable to make an installation of lamps where the potential of the series arc or incandescent circuit—the only circuit available—is too high for the application in question and the cost of running a multiple circuit from the central station would be prohibitive.

For such a proposition, Westinghouse safety coils are the economical solution. They are especially useful on installations as follows:

1—Where a series lighting system is desirable but high potentials are impracticable:

- (a.) On side streets or alleys where to run the main series circuit would require a new pole line. The comparatively low voltage safety-coil circuit can often be run on an existing telephone pole line.
- (b.) On bridges and in subways where the high potential of the regular series circuit is prohibitive.
- (c.) For lighting of fire-alarm, police, and letter boxes, where high potentials so near the ground would be dangerous.

2—Where a few lamps are wanted in a building and a multiple circuit is not available.

3—Where large lamps of high current must be operated from high-voltage series circuits such as white-way posts and pendent fixtures on mast arms having long loops.

### Operation

The primary of these coils is connected in the regular series circuit, while the secondary supplies the lower potential series circuit. Regular series lighting fixtures (such as those with film-cutouts) should be used, except where the secondary voltage does not exceed 200 volts, in which case the puncturing of films is unreliable and multiple sockets may be used.

Safety coils of 2 kilowatts and less may be operated continuously on open circuit without injury; those

of larger size will operate two hours without injury.

**Film Protective Device**—To prevent damage in case of an accidental open circuit in the secondary winding, a film protective device is recommended. This device is equipped with a film which, when connected across the secondary terminals of the safety coil, punctures under the open circuit voltage and thereby establishes a short circuit.

### Construction

These safety coils are series transformers insulated for high voltages (being tested for 20,000 volts for one minute between windings and between windings and iron.)

**In Sheet-steel Case**—The safety coils of 500 watts or less are of the core-type construction with a case of sheet-steel, gum-filled. For manhole service, outlets of a heavy pipe are provided, so tinned that a joint with lead-covered cable may be wiped to them. Small feet or mounting straps for supporting the transformer in the base of the hole are conveniently arranged. For overhead service, the leads are brought out through the bottom in porcelain bushings and a strap is provided on the side for mounting on a pole.

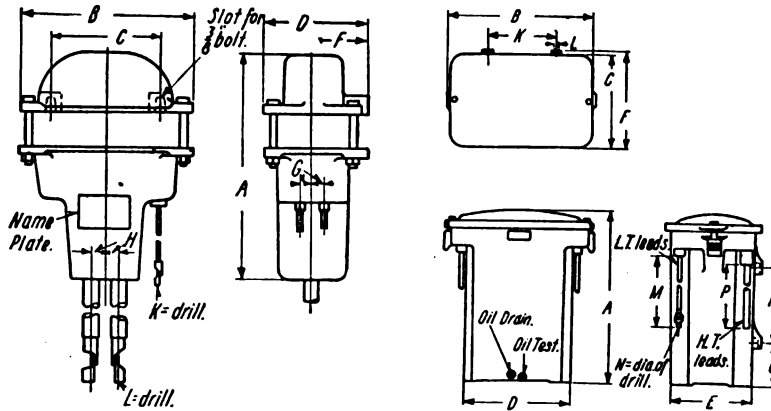
**Type MA (Dry-Type)**—The 1 and 2 kilowatt size are air cooled and of the same construction as the type MA current transformers. The magnetic circuit, with laminations exposed to the air, is clamped between cast-iron end-caps which protect the windings, the leads extending downwards through suitable bushings in the bottom end-cap. The coils are impregnated with an insulating compound which thoroughly seals up joints between the laminations and end-caps.

**Type SK (Oil-Insulated)**—The larger capacities of these coils are oil-insulated and have the same form of construction as the type SK distribution transformers (see section 4-A "Distribution Transformers").

SAFETY COILS—Continued

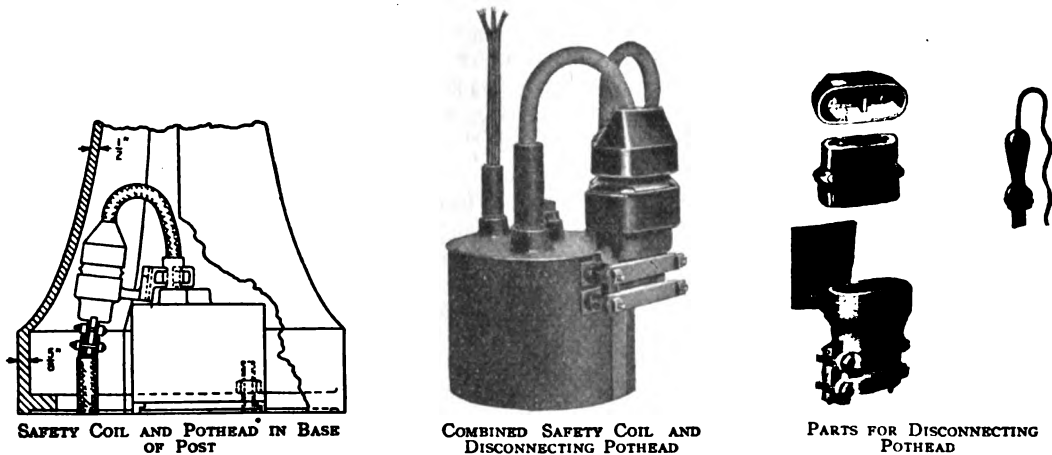
OUTLINE DIMENSIONS

Types SK (Oil-Insulated) and MA (Dry Type)



Style No.	Kv.-a.	Fig. No.	DIMENSIONS IN INCHES CORRESPONDING TO LETTERS GIVEN IN OUTLINE VIEWS												
			A	B	C	D	E	F	G	H	K	L	M	N	P
249428	1	6	15 1/4	9 1/4	6 1/4	5 1/4	...	3 1/4	5/8	3/4	...	...	...	...	...
249430	2	6	15 1/2	11 1/4	7 1/2	7 1/4	...	4 1/2	3/4	3/4	...	...	...	...	...
249433	5	7	23 1/2	19 3/4	12 3/4	14 1/4	10 1/2	13	6 1/4	10	9	11	18	.168	24
249435	10	7	25 1/2	22 3/4	14 3/4	15 3/4	12 3/4	15 1/4	3 3/8	16	11	11	21	.168	24

COMBINED SAFETY COIL AND DISCONNECTING POTHEAD



In most up-to-date ornamental post installations, it has been found that the advantages of both the safety coil and the disconnecting pothead are very desirable. To meet these requirements, the combination illustrated above has been designed.

The pothead consists of a cast iron body with double bonding clamps for the cable and a disconnecting and short circuiting switch enclosed in a porcelain case. It is attached rigidly to the case of the safety coil, and the combination is located in a position easily accessible through the door opening.

The two bonding clamps are so arranged that one of them bonds the steel armor, and the other the lead sheath of the underground cable, thus preventing the accumulation of static voltage, which might

be injurious to the cable insulation. Cable connections are made to screw terminals in the porcelain case of the disconnecting switch, and the pothead body is filled with an insulating compound which thoroughly seals the joint.

The primary leads of the safety coil are connected directly to the removable cap of the pothead. The contacts are so arranged that the removal of the cap disconnects the coil from the line, and, at the same time, connects the two cable ends together, thus maintaining the continuity of the series circuit. A testing plug is provided with which the underground system can be subdivided and tested at any time without the necessity of cutting the cable.

For 6.6 Ampere, 60 Cycle Circuits

Capacity Kva	Lamp Lumens	Secondary Amp.	Secondary Volt.	Style No.	Ship. Wt., Lbs., Each	List Price
.220	4000	15	15	351453	50	\$38 00
.316	6000	20	16	353243	58	38 00
.518	10000	20	26	351454	60	48 00

**SAFETY COILS—Continued**

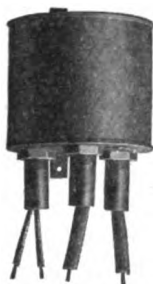


FIG. 3



FIG. 4



FIG. 5

Style number and list price include safety coil and (for the oil-insulated) the necessary oil and hanger irons for pole mounting.

**For 6.6-Ampere Circuits, Line Voltage of 6600**

Capacity Kv-a.	Fig. No.	Secondary Amperes	Maximum Secondary Volts	APPROX. WT., Net	LBS. Shipping	Style No. Hanger Irons	Gal. Oil	Style No.	List Price
<b>In Sheet-Steel Case (Gum-Filled)</b>									
.075	3	6.6	11	18	38	.....	.....	316775	\$25 00
.450	3	6.6	68	28	48	.....	.....	316776	42 00
.220	3	15	15.3	20	40	.....	.....	316777	28 00
.316	3	20	15.5	28	48	.....	.....	242378	30 00
.518	3	20	25.9	30	50	.....	.....	242380	41 00
.075	4	6.6	11	18	38	.....	.....	242381	25 00
.450	4	6.6	68	28	48	.....	.....	378099	42 00
.220	4	15	15.3	20	40	.....	.....	359566	28 00
.316	4	20	15.5	28	48	.....	.....	359567	30 00
.518	4	20	25.9	30	50	.....	.....	359568	41 00
.075	5	6.6	11	18	38	.....	.....	245648	25 00
.450	5	6.6	68	28	48	.....	.....	369823	42 00
.220	5	15	15.3	20	40	.....	.....	245645	28 00
.316	5	20	15.5	28	48	.....	.....	245646A	30 00
.518	5	20	25.9	30	50	.....	.....	245647	41 00
<b>Type MA (Dry-Type)</b>									
1.00	2	6.6	152	56	65	.....	.....	249428	65 00
2.00	2	6.6	304	93	110	.....	.....	249430	83 00
<b>Type SK (Oil-Insulated)</b>									
5.00	1	6.6	760	230	333	109713	8	249433	145 00
10.00	1	6.6	1520	346	508	109713	11½	249435	230 00

**FILM PROTECTIVE DEVICE**

**For Type SK (Oil-Insulated) Safety Coils**

Capacity Kv-a.	Fig. No.	Secondary Amp.	Maximum Closed Circuit Voltage	APPROX. WT., Net	LBS. Ship.	Style No. Film	Style No.	List Price
5.00	8	6.6	750	5	10	353801	332722	\$10 00
10.00	8	6.6	1520	5	10	353802	332722	10 00

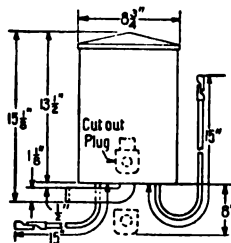


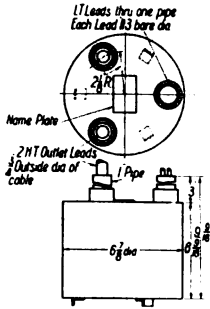
FIG. 8

These dimensions are for reference only. For official dimensions apply to nearest district office.

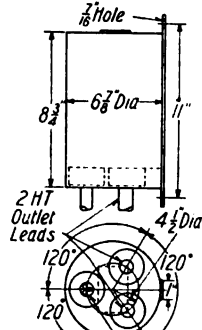
**Order by Style Number**

SAFETY COILS—Continued

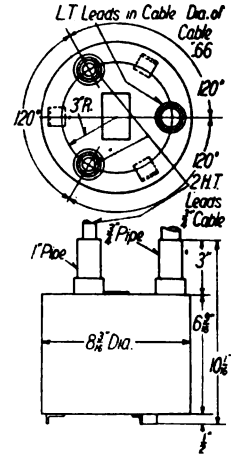
OUTLINE DIMENSIONS



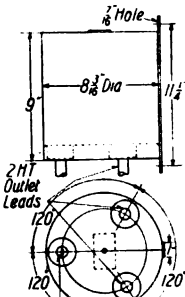
STYLE No. 322027



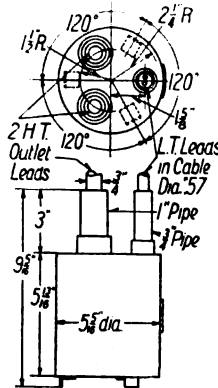
LT Leads in Cable  
STYLE No. 316777



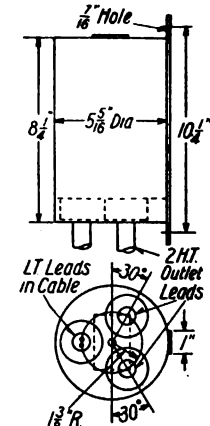
STYLE NOS. 242377, 242379  
AND 242383



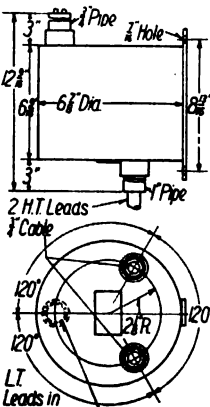
LT Leads in Cable  
STYLE NOS. 242378, 242380  
AND 316776



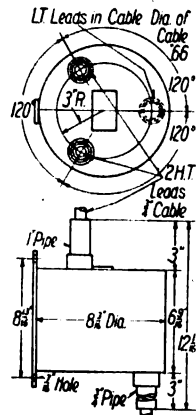
STYLE No. 242381



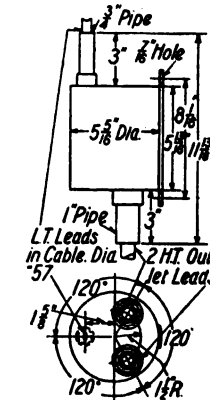
STYLE No. 316775



STYLE No. 245645



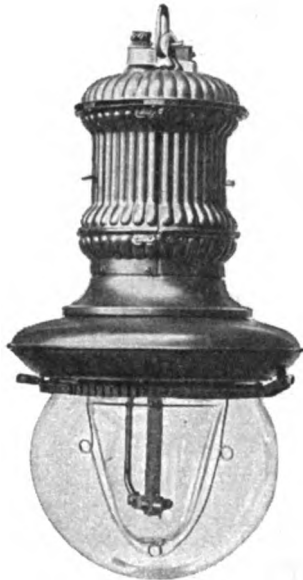
STYLE NOS. 245646, 245647 AND 245649



STYLE No. 245648

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## TYPE H FLAME-CARBON ARC LAMPS



D-C. MULTIPLE

**Applications**—For factories, warehouses, mills, and other large industrial plants where the intensity of illumination should be uniform over the working surface, as well as for street, park, and boulevard lighting, these lamps give excellent and efficient illumination. Their exceptionally substantial construction and wide light distribution make them the best lamps to use in outdoor construction work, in quarries, in railroad yards, etc. Their intense illumination at low cost also makes them very desirable for display lighting in front of stores or theatres, or for the lighting of public squares.

Equipped with yellow-light carbons, which can be furnished instead of white-light carbons without additional cost, the lamps produce a light of great intensity and high penetrating power for the smoky and dusty interiors of foundries, train sheds, steel mills, and similar places. For marine work, on docks, etc., this yellow light is particularly desirable to penetrate fogs.

**Carbons**—A homogeneous, impregnated carbon,  $\frac{7}{8}$  by 14 inches, is used in these lamps. An average life of approximately 130 hours per trim is obtained.

### PERFORMANCE

**A-C. series lamps**—When the standard lamp is adjusted for 10 amperes and 53 volts at terminals, the approximate performance on a 60-cycle circuit will be as follows:

Arc voltage.....	47.5
Lamp power factor.....	84%
Lamp watts.....	445
Electrical efficiency of lamp.....	91%

**A-C. multiple lamps**—When adjusted for 10 amperes and 48 volts at the arc, the approximate performance of the 110-volt, 60-cycle standard lamp operated on a 110-volt circuit will be as follows:

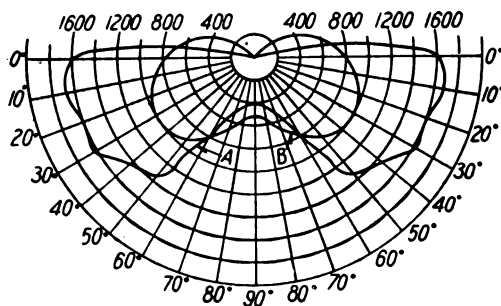
Lamp power factor.....	60.5%
Lamp watts.....	500

Electrical efficiency..... 86%

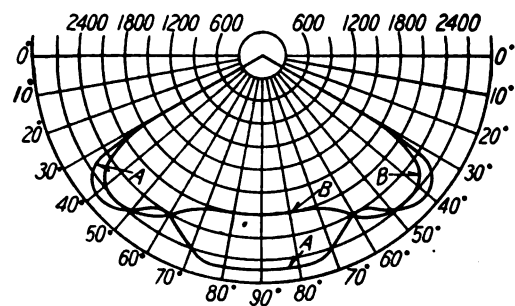
Performance of lamps of other ratings will be furnished on request.

**Operation on other circuits**—Standard 10-ampere lamps may be operated on series circuits of lower current value by using an auto-transformer with each lamp. The transformer may be placed in the lamp or mounted separately. The externally mounted transformer is entirely weather-proof and is arranged for mounting directly above the lamp. In case the secondary accidentally open-circuits, the auto-transformer will operate continuously without injury to the windings.

**D-C. lamps**—Performance is given in table of style numbers and list price.



DISTRIBUTION CURVE OF A-C. SERIES LAMP



DISTRIBUTION CURVE OF MULTIPLE LAMPS WITH INDUSTRIAL REFLECTOR

TYPE H FLAME-CARBON ARC LAMPS—Continued

A-C. SERIES LAMPS

Style number includes lamp complete with one set of carbons and glassware. In ordering, state whether white-light or yellow-light carbons are desired, and also the kind of glassware wanted. Also indicate voltage variation; i. e., maximum and minimum circuit voltage.

Style No.	Frequency Cycles	Current Amperes	Amperes at Arc	Fig. No.	Dimension A, Inches	APPROX. WT., LBS.		List Price
						Net With Glassware	Shipping Without Glassware	
217636	60	10*	9.5	1	31 1/4	53	96	
219431	60	6.6 or 7.5†	10.	1	36 1/2	68	120	On Request
221089	50	10	9.5	1	36 1/2	68	120	
221088	25	10	9.5	1	38	78	133	

\*The external auto-transformer listed below can be supplied for use with this lamp on 6.6 or 7.5-ampere circuits.

†Auto-transformers are contained in these lamps.

Information on lamps for other frequencies will be furnished on request.

AUTO-CURRENT TRANSFORMERS FOR A.C. SERIES LAMPS

Style number covers auto-transformer with taps for operating one 10-ampere lamp on either a 6.6 or a 5.7-ampere, 60-cycle circuit.

Style No.	Frequency Cycles	Current Amperes	Amps. at Arc	APPROX. WT., LBS. Net	Shipping	List Price
107516	60	6.6 or 7.5	10	14	30	On Request

A.C. MULTIPLE LAMPS

Style No.	Frequency Cycles	Normal Terminal Voltage	Range of Adjustment Volts	Amps. at Arc	Approx. Amps. at Terminals	APPROX. WT., LBS. Net With Glassware	Shipping Without Glassware	List Price
219430	60	110	100 to 125	10	7 to 7.5	65	125	
217637	60	220	200 to 250	10	3.5 to 4	70	132	On Request
217638	50	110	100 to 125	10	7 to 7.5	65	125	
217639	50	220	200 to 250	10	3.5 to 4	70	132	
217640	25	110	100 to 125	10	7.5 to 8	78	140	

D.C. MULTIPLE LAMPS

Style No.	Current Amperes	Voltage Range	No. of Lamps in Series	Normal Terminal Voltage Per Lamp	Approx. Arc Voltage	APPROX. WT., LBS. Net With Glassware	Shipping Without Glassware	List Price
217641	6.5	100 to 125	1	110	70	49	92	On Request

\*D.C. MULTIPLE-SERIES LAMPS

221136	10	100 to 125	2	55	40	53	96	On Request
221134	6.5	200 to 250	2	110	70	53	96	On Request

\*The multiple-series lamps have no substantial resistor and therefore cannot be used on circuits of higher voltage than listed. If one lamp in a series goes out of service, the other ceases to burn.

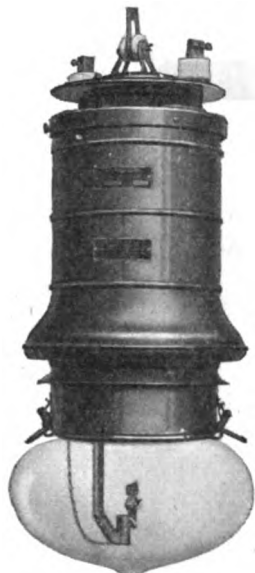
INDUSTRIAL REFLECTORS

Style No.	Description	List Price
202748	Reflector only	On Request
202749	Reflector with spacers	On Request

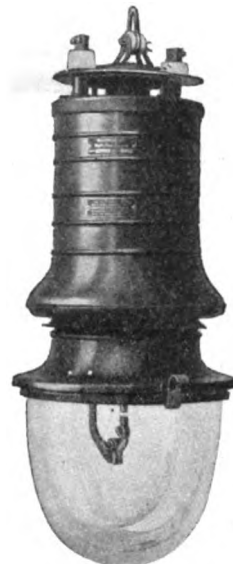
Order by Style Number

## METALLIC-FLAME SERIES ARC LAMPS

### TYPES B AND C—FOR DIRECT-CURRENT CIRCUITS



TYPE B LAMP



TYPE C LAMP

Westinghouse metallic-flame arc lamps represent the most advanced development in direct-current arc lamp practice for the lighting of large areas. The distribution of the light is ideal for street illumination or for railway shops and yards and other areas where high voltage is not prohibited. Its intense, white color, resembling daylight, makes it particularly desirable for such service. These series lamps can be operated only on constant direct current, obtained either by means of rectifier constant-current regulators or directly from constant-current arc generators of the proper current rating.

In the Westinghouse lamps the vapors produced by the metallic oxides of which the electrodes are composed, are not permitted to come in contact with any solid substance in the lamp chamber, and therefore do not deposit as soot. The construction is such that air currents pass down over the inner surface of the globe and down along the electrodes, then out through a chimney. These air currents serve to carry off the vapors and soot and also to steady the arc so that it does not run up the side of the upper (negative) electrode.

**Distribution of Light**—The negative electrode is on top, so that most of the light is thrown downward. A corrugated enameled reflector is provided in the type C lamp to utilize the small part of the

light emitted above the horizontal, and the globe is so designed that reflections from it are in a downward direction. The reflector is attached to the case and comes off with it when the lamp is opened. It is not necessary to loosen the reflector screws. In the type B lamp a globe containing an opaque reflector in the upper half can be furnished. The type B lamp does not have a metal reflector. In both types the lower electrode is stationary and the upper electrode feeds, maintaining the arc always within  $\frac{1}{2}$  inch of the same position.

**Accessories**—For information concerning glassware, electrodes, etc., see pages covering "Arc Lamp Accessories."

**Prices**—Style number includes lamp complete with globe and one set of electrodes, and with globe screen when desired.

Style No.	Type	Current	Watts	List Price
162498	C	6.6	449	Prices on Request
162497	C	4.0	272	
126199	B	6.6	449	
126200	B	4.0	272	

#### Approximate Weight

Net, with glassware—Type B, 42 lbs.; type C, 45 lbs.

Shipping, without glassware—Type B, 65 lbs.; type C, 68 lbs.

*Order by Style Number*

METALLIC-FLAME SERIES ARC LAMPS—Continued

**ELECTRODES**

For Westinghouse Metallic-Flame Series Arc Lamps

Prices on request



UPPER OR NEGATIVE

Upper or Negative

Style No.	Length	Amperes of Circuit	Shipping Weight, Lbs. per 1000
146648	12-in.	4	550
146649	16-in.	4	
145368	16-in.	6.6	

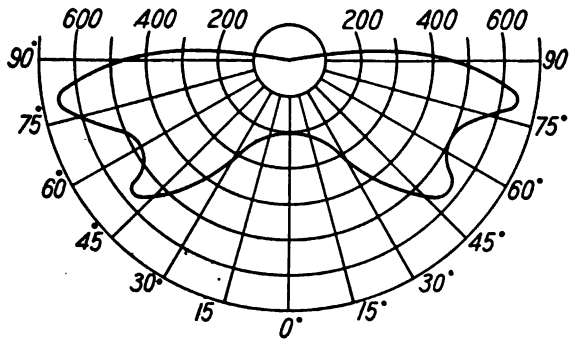


LOWER OR POSITIVE

Lower or Positive

Style No.	Amperes of Circuit	Shipping Weight, Lbs. per 1000
236840	4	85
248504	6.6	100

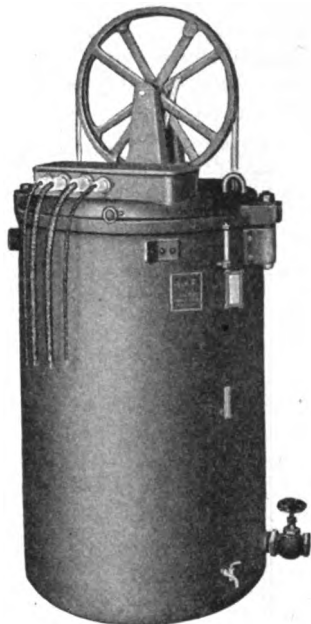
Order by Style Number



DISTRIBUTION CURVE OF 4-AMPERE, D.-C., SERIES METALLIC-FLAME ARC LAMP



## WESTINGHOUSE COOPER-HEWITT RECTIFIER CONSTANT-CURRENT REGULATING TRANSFORMERS



50-LIGHT OUTFIT COMPLETE

adapted for use with the Westinghouse metallic flame arc lamps. They are used in connection with the control panels described on other pages of this catalogue.

### Ratings and Style Numbers

Style number and list price include regulating transformer with oil bulb single-throw control panel and lightning arresters. For style numbers of bulbs see below.

No. Light	Cap. Amps.	2200 Volts		List Price
		25-Cycle	60-Cycle	
		STYLE No.		
25	4	108701	108897	†
35	4	108702	108898	†
50	4	108703	108899	†
75	4	108704	108700	†
100	4	.....	138141	†
25	6.6	.....	108705	†
35	6.6	.....	108706	†
50	6.6	108711	108707	†
75	6.6	108712	108708	†

†Prices furnished on request.

### Cooper-Hewitt Rectifier Bulbs

Style number and list price cover bulb complete ready to be connected into the circuit.

Style No.	Description	Prices Furnished
95504-E	For all outfits	On Request
	Approx. weight of one bulb packed in crate is 20 pounds.	
	Approx. weight of two bulbs packed in crate is 25 pounds.	

### Incandescent Lamps on Rectifier Circuits

Because of their greater efficiency, incandescent type C lamps are gradually replacing arc lamps on street lighting circuits which are operated from rectifiers. By reconnecting the constant current transformers, alternating current is supplied to the secondary circuit. Complete information for making changes on existing installations will be furnished on request. Lamp data is shown on page 959.

**Application**—The Westinghouse Cooper-Hewitt rectifier outfits described herein are designed to permit the operation of direct-current series arc lighting systems from single-phase alternating-current circuits. By the use of these outfits, the advantages gained from alternating-current distribution at any commercial frequency are combined with the superior illuminating qualities of direct-current arc lamps. The outfits are applicable to any type of direct-current series arc lamps but are especially

### APPROXIMATE WEIGHTS AND OUTLINE DIMENSIONS

Cycles	Capacity in Lights	WEIGHTS		Gals. Oil*	Greatest Width Including Valve	OVERALL DIMENSIONS			
		WITHOUT OIL Net	Gross			Width of Top Including Lugs	Height	Diameter of Tank	Height to Center Line of Terminals
<b>4-Ampere Rectifier Outfits</b>									
25	25	3400	4400	320	4'-6 1/8"	4'-0 3/4"	8'-1 1/8"	3'-6 1/8"	5'-6 1/8"
	35	4500	5700	535	5'-4 3/8"	5'-1"	9'-3 3/8"	4'-"	5'-9 1/8"
	50	5000	6400	535	5'-3 1/8"	4'-11 1/8"	9'-3"	5'-4 1/2"	5'-9 1/8"
	75	6400	8100	680	5'-10 3/8"	5'-3 3/8"	10'-1 1/8"	4'-9"	6'-3 1/8"
60	25	2800	3700	350	4'-6 1/8"	4'-0 3/4"	8'-1 1/8"	3'-6 1/8"	5'-7"
	35	2950	3900	335	4'-6 1/8"	4'-0 3/4"	8'-1 1/8"	3'-6 1/8"	5'-6 1/8"
	50	3100	4100	335	4'-6 1/8"	4'-0 3/4"	8'-1 1/8"	3'-6 1/8"	5'-6 1/8"
	75	4500	5800	535	5'-3 1/8"	4'-11 1/8"	9'-3"	4'-4 1/2"	5'-9 1/8"
100	6400	7800	625	5'-9 3/8"	4'-11 1/8"	8'-4 3/8"	4'-9 1/8"	5'-11"	
<b>6.6-Ampere Rectifier Outfits</b>									
25	50	8100	10300	750	6'-2 3/8"	5'-6 1/2"	10'-6"	5'-0 1/2"	6'-3"
	75	8400	10900	730	6'-2 3/8"	5'-6 1/2"	10'-6"	5'-0 1/2"	6'-3"
60	25	3000	3900	335	4'-7 3/8"	4'-3 3/8"	8'-1 1/8"	3'-6 1/8"	5'-6 1/8"
	35	3200	4200	320	4'-7 3/8"	4'-3 3/8"	8'-1 1/8"	3'-6 1/8"	5'-6 1/8"
	50	4500	5900	525	5'-3 3/8"	4'-11 1/8"	9'-3"	4'-4 1/2"	5'-9 1/8"
	75	5700	7400	700	5'-9 3/8"	5'-3 3/8"	10'-1 1/8"	4'-9"	6'-3 3/8"

\*Oil weighs approximately 7 1/2 pounds per gallon net.

NOTE—The above dimensions are for reference only. For official dimensions apply to the nearest district office of this company.

Order by Style Number

## CONTROL PANELS

### FOR COOPER-HEWITT RECTIFIER CONSTANT-CURRENT REGULATING TRANSFORMERS

The panel consists of a single slab of marble having the apparatus mounted thereon, bolted to a tubular iron frame which is, in turn, bolted to the floor. The total height of the panel from the floor is 6 feet 4 $\frac{3}{8}$  inches.

**Marble**—The marble slab is of black marine finish, 48 inches high, 1 $\frac{1}{2}$  inches thick, with the front edges beveled  $\frac{3}{8}$ -inch. It is bolted at the four corners to lugs on the frame. The switches and meters are mounted directly on the marble.

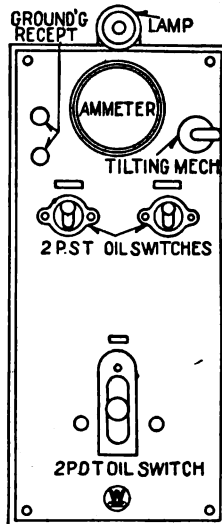
**Frame**—The type J frame is supplied with these panels. This frame is made from 1 $\frac{1}{4}$ -inch gas pipe uprights which are screwed into foot-nuts adapted for bolting to the floor. Each upright is supplied with a gas-pipe rod and foot-nut for bracing the panel to the floor or to the wall, as may be desired.

Two enclosed fuse blocks and fuses for constant-potential circuit.

One tilting handle for rectifier.

Two testing receptacles and necessary plugs.

One bell-ringing relay.



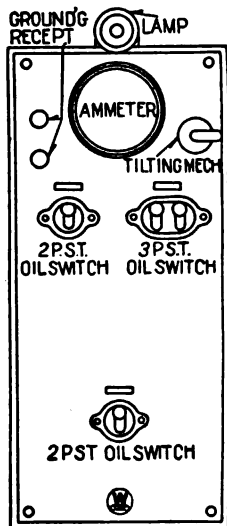
SINGLE-THROW PANEL  
25-35-50 LIGHT

#### FOR 25, 35 AND 50 ARC LAMPS

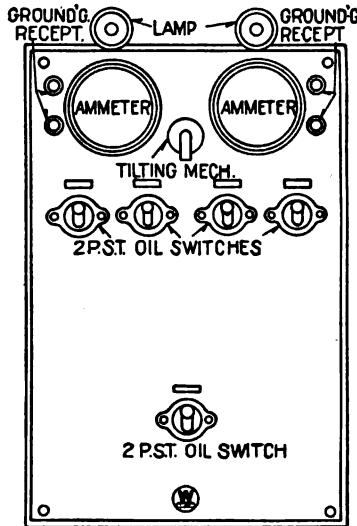
##### Schedule of Apparatus

- One type SL direct-current high-tension ammeter.
- One two-pole type I oil switch for arc circuit.
- One two-pole type I switch for starting.
- One series incandescent lamp and bracket.
- One two-pole single-throw primary oil switch for constant-potential circuit.

#### FOR 75 AND 100 ARC LAMPS



SINGLE THROW PANEL  
75-LIGHT



SINGLE-THROW PANEL  
100-LIGHT

##### Schedule of Apparatus

75-Light	100-Light
1	2
1	2
1	2
1	2
1	2
*1	*1
2	2
1	1
2	4
1	2

- Type SL (Type TL for 75-light) direct-current high-tension ammeters.
- Two-pole type I oil switches for arc circuits.
- Three-pole two-handle special type I oil switches for starting.
- Two-pole type I oil switches for starting.
- 10 ampere, 800 lumen series incandescent lamps and brackets.
- Two-pole single-throw primary oil switch for constant-potential circuit.
- Enclosed fuse blocks and fuses for constant-potential circuit.
- Tilting handle for rectifier.
- Testing receptacles and necessary plugs.
- Bell-ringing relays.

\*On double-throw panels the primary oil switch is double-throw.

## ARC LAMP ACCESSORIES

The globes, bulbs, reflectors and other sundries listed in this section are especially designed for use with the arc lamps manufactured by the Westinghouse Electric & Manufacturing Company. The variety of designs listed enables the user to select that design which suits his particular conditions of service, there being a design suited to any one of the services for which the arc lamps may be used.

A variety of grades of glassware is listed in order to enable the user to select that grade best suited to his uses.

**Clear Glass** is recommended where the high intrinsic brilliancy is not objectionable, as it gives the highest illuminating efficiency. It can be used satisfactorily with most street-lighting systems and with interior lighting where the lamps are hung high.

**Opal glass** absorbs some of the superfluous violet rays of the light without seriously decreasing the illuminating efficiency. Globes of this glass eliminate to a considerable extent the glare which accompanies the clear glass, producing a pleasant, diffused light, well adapted to street and interior lighting. This glass is distinguished by a pure milky color running evenly throughout its thickness.

**Alabaster glass** is composed of a thin film of opal glass overlaid with a clear glass. This reduces the

illuminating efficiency somewhat, but the quality of light is much improved. Globes of this glass are recommended for use where a soft mellow light is desired. The globe acts as a secondary source of light, appearing pearl white of low intrinsic brilliancy. There is an entire absence of glare and shadows.

**Opalescent glass** is a similar grade to alabaster, but not quite so dense.

**Alba glass** is a crystal base uniformly permeated with innumerable minute, opaque, white particles. These deflect transmitted light rays into myriads of paths, producing a very even diffusion of light throughout the entire volume of glass. Alba globes have good diffusion and small absorption. They soften the light with a comparatively small loss and do not cause the distortion of the true color of the light source.

When used as a reflector, alba glass transmits enough light for excellent ceiling illumination, but deflects the larger proportion below the horizontal.

**Marbo glass** is a semi-opaque glass with diffusing properties. While not as efficient as clear glass, it gives a softer light, practically free from glare.

**Monax glass** is similar to alba glass but is of somewhat greater density and uniformity.

### GLASSWARE—Prices on Request

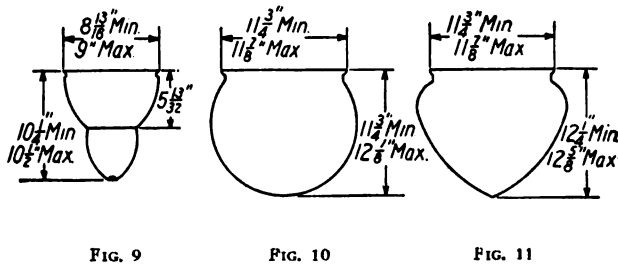
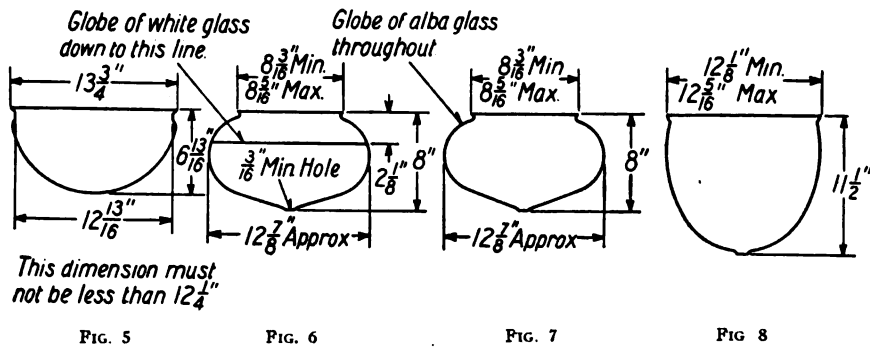
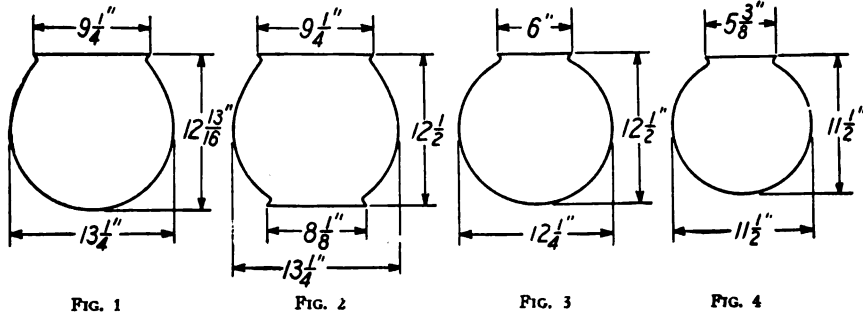
Used With Lamp Style No.	Style No. Glassware	Description	Fig. No.	Net Each	APPROX. Wt. Lbs. Shipping per Pack.	Used With Lamp Style No.	Style No. Glassware	Description	Fig. No.	Net Each	APPROX. Wt. Lbs. Shipping per Pack.		
<b>For Westinghouse Flame-Carbon Arc Lamps</b>													
<b>Alternating-Current Series</b>						<b>Direct-Current Multiple and Series</b>							
<b>Outer Globes</b>						<b>Inner Bulbs</b>							
30082	}	27034	Clear	1	5	115	36047	}	35289-A	Clear	14	$\frac{1}{4}$	60
38000		30059	Opal	1	5	115	36048		35290-A	Opal	14	$\frac{1}{4}$	60
38001		30080	Light, alabaster	1	5	115	36053						
50403-A							36054						
		38919	Clear, open bottom	2	3 $\frac{1}{2}$	115	59523						
50404-A						59524							
						59525							
<b>Inner Bulbs</b>						<b>Direct-Current Multiple Series</b>							
38000	}	35286-A	Clear	13	$\frac{1}{2}$	60	86049	}	27034	Clear	1	5	115
38001		35287-A	Opalescent	13	$\frac{1}{2}$	60	103689		30059	Opal	1	5	115
38002									30080	Light alabaster	1	5	115
38003													
50403-A													
50404-A													
50405-A													
50406-A													
30082	}	27035	Clear	12	$\frac{1}{2}$	60	36049	}	35289-A	Clear	14	$\frac{1}{4}$	60
30083		30061	Opalescent	12	$\frac{1}{2}$	60	36050		35290-A	Opal	14	$\frac{1}{4}$	60
							103689						
							103691						
<b>Alternating-Current Multiple</b>						<b>Direct-Current Multiple Mill Type</b>							
<b>Outer Globes</b>						<b>Outer Globes</b>							
38008	}	37962	Clear	3	4	115	85784	}	37962	Clear	3	4	115
38007		40649	Opal	3	4	115	104790		40649	Opal	3	4	115
92248-A													
92250-A													
<b>Inner Bulbs</b>						<b>Inner Bulbs</b>							
38008	}	35286-A	Clear	13	$\frac{1}{2}$	60	85756	}	74645	Clear	15	$\frac{1}{4}$	60
38007		35287-A	Opalescent	13	$\frac{1}{2}$	60	85784		74646	Opalescent	15	$\frac{1}{4}$	60
38045							104789						
38046							104790						
92248-A													
92249-A													
92250-A													
92251-A													
<b>Direct-Current Multiple and Series</b>						<b>Manhattan Type</b>							
<b>Outer Globes</b>						<b>Outer Globes</b>							
36047	}	37962	Clear	3	4	115	601, 601-A	}	301	Clear	4	4	115
36053		40649	Opal	3	4	115	602, 602-A		301	Alabaster	4	4	115
59523							603, 603-A						
						653, 653-A							
<b>Inner Bulbs</b>						<b>Inner Bulbs</b>							
							601, 601-A	}	12	Clear	16	$\frac{1}{4}$	60
							602, 602-A		12	Alabaster	16	$\frac{1}{4}$	60
							603, 603-A						
							653, 653-A						



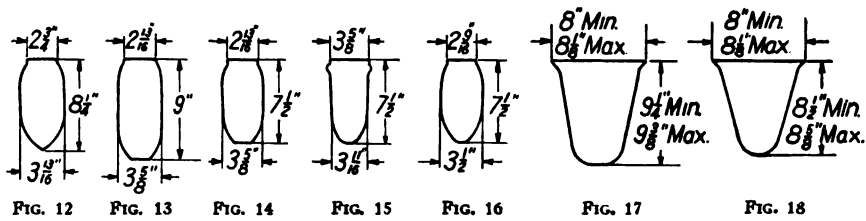
ARC LAMP ACCESSORIES—Continued

OUTLINE DIMENSIONS

Outer Globes



Inner Bulbs



ARC LAMP ACCESSORIES—Continued



STYLE No. 187299



STYLE No. 57968



STYLE No. 104162

**BRUSHES**

Style No.	Description
57968	Inner globe brush.
104162	Chimney tube brush for metallic-flame lamp.
187299	Condensing chamber brush for flame-carbon lamp.

Prices on Request

**MAGNESIA CONSUMERS**

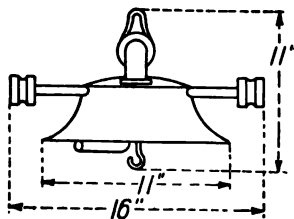
**For Westinghouse-Stave and Type H Flame-Carbon Arc Lamps**

Style No. 177455-B consists of one set of magnesia consumer material made up in a wire gauze holder ready for insertion in any of the Westinghouse-Stave or type H flame-carbon arc lamps. Price on request.

**ABSOLUTE CUT-OUT ARC LAMP HANGERS**

**For A-C. and D-C. Series Lamps**

Prices on Request



STYLE No. 35297  
Weight, 17 pounds, net.  
Weight, 35 pounds, packed



STYLE No. 35297

**CARBONS**

**For Westinghouse Enclosed Arc Lamps**

Columbia carbons are carried in stock. In ordering state the diameter and length of carbon with description, i. e., cored or solid. Prices on request.

**For Westinghouse Flame-Carbon Arc Lamps**

Columbia carbons are carried in stock. In ordering be sure to state style number of lamp, size, of carbons, color of light and whether for alternating-current or direct-current lamps. Prices on request.

**CONTAINER BOX FOR HIGH-TENSION RECTIFIER BULB**

Style number of bulb box does not cover lifting strap which should be ordered as follows:

Style No.	Description
156452	Container box complete except lifting strap.

**Lifting Straps**

Style No.	Rating of Rectifier	Prices on Request
99553	25-light, 4-amp., 60-cycle	} Prices on Request
	35-light, 4-amp., 60-cycle	
	50-light, 4-amp., 60-cycle	
	25-light, 4-amp., 25-cycle	
	25-light, 6.6-amp., 60-cycle	
99596	35-light, 6.6-amp., 60-cycle	} Prices on Request
	75-light, 4-amp., 60-cycle	
	35-light, 4-amp., 25-cycle	
	50-light, 4-amp., 25-cycle	
106568	50-light, 6.6-amp., 60-cycle	} Prices on Request
	75-light, 4-amp., 25-cycle	
	75-light, 6.6-amp., 60-cycle	
	50-light, 6.6-amp., 25-cycle	
107482	75-light, 6.6-amp., 25-cycle	} Prices on Request
107483	100-light, 4-amp., 60-cycle	
107483	100-light, 6.6-amp., 60-cycle	Prices on Request

# WESTINGHOUSE MAZDA LAMPS

## GUIDE TO CONSIGNMENT OF MAZDA LAMPS

For Use by Agents when Requesting Stocks Required for Proper Service to Agents and Purchasers they Serve

GENERAL LIGHTING SERVICE 110-115-120 Volts			SPECIAL LIGHTING SERVICE			
<b>GROUP I</b> Lamps maintained in the consigned stock for retail agents selling lamps for general lighting service, will be supplied from the following:			<b>GROUP I—SPECIAL</b> Lamps maintained in the consigned stock for retail agents known to be selling lamps for some special lighting service, will be supplied from the following lamps for such special service.			
10 watt S-17 Clear	220, 230, 240 and 250 Volts	Sign	Country Home Lighting	Projection		
15 watt S-17 Clear	25 watt S-19 50 watt S-19 100 watt PS-25	10 watt S-14 115 Volt	10 watt S-17 Clear	100 watt G-25		
25 watt S-17 Clear		25 watt P-19 Blue	25 watt S-17 Clear	250 watt T-14		
25 watt S-17 Frosted		Floodlighting		40 watt S-19 Clear	400 watt T-20	
25 watt G-18 1/2 Frosted				50 watt PS-20 Clear	600 watt T-20	
40 watt S-19 Clear				50 watt PS-20 White	900 watt T-20	
40 watt S-19 Clear	Mine	Street Railway	Train	Street Series		
40 watt S-19 Clear	None	None	None	None		
50 watt S-19 Clear	<b>GROUP II—SPECIAL</b> Lamps maintained in the consigned stock for agents serving purchase contracts, requiring lamps for some special lighting service, will be supplied from lamps in Group I-Special and from the following, for such special service.					
50 watt PS-20 White	220, 230, 240 and 250 Volts	Sign	Country Home Lighting	Street Series		
60 watt S-21 Clear	50 w. P-19 Clear	5 watt S-14 12 Volts	15 watt S-17 Clear	600 lumens 6.6 amp.		
75 watt S-22 Clear	100 w. S-30 Clear	5 watt S-14 60 Volts	20 watt S-17 Clear	800 lumens 6.6 amp.		
75 watt PS-22 Daylight	100 w. PS-25 B.Enl.	50 watt P-19 Blue	25 watt PS-16 White	1000 lumens 6.6 amp.		
100 watt PS-25 Clear	200 w. PS-30 Clear	Floodlighting		2500 lumens 6.6 amp.		
100 watt PS-25 Clear	200 w. PS-30 B.Enl.			4000 lumens 6.6 amp.		
150 watt PS-25 Clear	300 w. PS-35 Clear			6000 lumens 6.6 amp.		
150 watt PS-25 Bowl Enamel	300 w. PS-35 B.Enl.	250 watt G-30	4000 lumens 15 amp.	4000 lumens 15 amp.		
200 watt PS-30 Clear	500 w. PS-40 Clear	500 watt G-40	6000 lumens 20 amp.	6000 lumens 20 amp.		
200 watt PS-30 Bowl Enamel	500 w. PS-40 B.Enl.	Mine—275 Volts	10000 lumens 20 amp.	10000 lumens 20 amp.		
200 watt PS-30 Daylight	Mine—275 Volts	Street Railway	600 lumens 4, 5.5 & 7.5 amp.	800 lumens 4, 5.5 & 7.5 amp.		
300 watt PS-35 Clear	50 watt P-19	23 watt S-17	800 lumens 4, 5.5 & 7.5 amp.	1000 lumens 4, 5.5 & 7.5 amp.		
300 watt PS-35 Bowl Enamel	100 watt S-30	36 watt S-19	10 watt S-17 30 Volts	15 watt S-17 30 Volts		
300 watt PS-35 Daylight	Floodlighting		15 watt S-17 33 V.Cab	15 watt G-18 1/2 30 V.		
500 watt PS-40 Clear			94 watt G-25	25 watt S-17 30 Volts	25 watt G-18 1/2 30 V.	
500 watt PS-40 Bowl Enamel			Mine—275 Volts	Train		
<b>GROUP III</b> Form B agents may carry in the consigned stock in their custody, in addition to such lamps as may be required from Group I-Special and II-Special, such of the following lamps for such special lighting service as may be necessary. These lamps will be shipped by the Form B agents direct to purchasers served either by them or by the retail agents they serve.			<b>GROUP III—SPECIAL</b> Form B agents may carry in the consigned stock in their custody, in addition to such lamps as may be required from Group I-Special and II-Special, such of the following lamps for such special lighting service as may be necessary. These lamps will be shipped by the Form B agents direct to purchasers served either by them or by the retail agents they serve.			
15 watt S-17 Frosted	220, 230, 240 and 250 Volts	Street Railway	Projection	Train		
15 watt B-9 1/2 Frosted	None	23 watt G-18 1/2	250 watt G-30	15 watt S-17 60 Volts		
15 watt G-16 1/2 Frosted	None	94 watt S-24 1/2	400 watt G-30	15 watt G-18 1/2 60 V.		
25 watt G-18 1/2 Frosted		Floodlighting		25 watt PS-16 30 V.	25 watt S-17 60 Volts	
25 watt G-25 Clear				25 watt G-18 1/2 60 V.		
50 watt PS-20 Clear				50 watt PS-20 30 V.		
50 watt G-25 Clear		Mine	Sign	Country Home Lighting	75 watt PS-22 30 V.	
50 watt PS-20 Clear	None	None	None	75 watt PS-22 60 V.		
50 watt PS-20 Daylight	Street Series	None	None	100 watt G-25 Hd.30V.		
75 watt PS-22 White	None			100 watt PS-25 30 V.		
750 watt PS-52 Clear	None			100 watt PS-25 60 V.		
1000 watt PS-52 Clear	None			250 watt G-30 Hd.30V.		

Lamps in Group IV comprise all other lamps in the Price Schedules of Standard Large MAZDA Lamps not given above, will be carried in Manufacturers' warehouses and will be shipped by the Manufacturer direct to Purchasers at Agents' request. Frosting—Any of the above lamps may be supplied frosted at small additional charge.

Current Price Schedule Furnished On Request

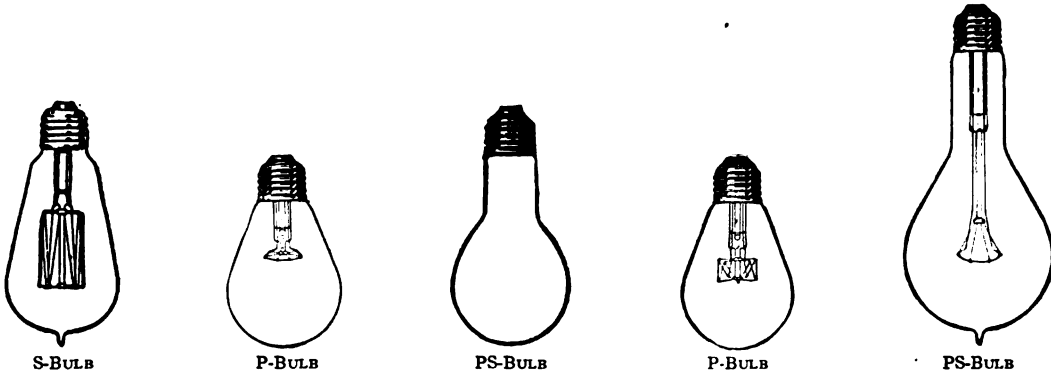
## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the United States

# WESTINGHOUSE MAZDA LAMPS

## FOR GENERAL LIGHTING SERVICE



These lamps constitute more than 75 per cent of the usual lamp demand for such service as residence, store and office lighting. The higher wattage sizes are used for various industrial and store lighting purposes. These lamps are for use on 110 to 125-volt and 220 to 250-volt lighting circuits. Proper reflector equipment should be provided to protect the eyes from the extremely bright filaments of MAZDA C lamps, especially whenever the lamps are hung low and in the usual line of vision.

### 110, 115 AND 120 VOLTS

#### Straight Side MAZDA B Lamps

#### Pear-Shape MAZDA C Lamps\*

Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Std. Pkg. Quantity	Consignment Classification	Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
10	80	S-17	2 1/8	5 1/4	Medium	120	I	50	500	PS-20	2 1/2	5 1/4	Medium	60	III
15	130							75	900	PS-22	2 3/8	6 1/4	Medium	60	I
25	240							100	1300	PS-25	3 1/8	7 1/4	Medium	24	I
40	400	S-19	2 3/8	5 1/4	Medium	120	I	150	2100	PS-25	3 3/8	7 1/4	Medium	24	II
50	500							200	3000	PS-30	3 3/4	8 1/4	Medium	24	II
60	620	S-21	2 3/8	5 1/4	Medium	120	I	400	4900	PS-35	4 3/8	9 1/4	Mogul	24	II
								500	7000	PS-40	5	10 1/4	Mogul	12	IV
								500	9000	PS-40	5	10 1/4	Mogul	12	II
								750	14500	PS-52	6 1/2	13 1/4	Mogul	8	III
								1000	20000	PS-52	6 1/2	13 1/4	Mogul	8	III

### 220, 230, 240 AND 250 VOLTS

#### Straight Side MAZDA B Lamps

#### Pear-Shape MAZDA C Lamps†

Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Std. Pkg. Quantity	Consignment Classification	Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
25	200	S-19	2 3/8	5 1/4	Medium	120	I-Spl.	100	1000	PS-25	3 1/8	7 1/4	Medium	24	I Spl.
50	450	S-19	2 3/8	5 1/4	Medium	120	I-Spl.	200	2600	PS-30	3 3/8	8 1/4	Medium	24	II Spl.
								300	4300	PS-35	4 3/8	9 1/4	Mogul	24	II Spl.
								500	7800	PS-40	5	10 1/4	Mogul	12	II Spl.
								750	12500	PS-52	6 1/2	13 1/4	Mogul	8	IV
1000	17500	PS-52	6 1/2	13 1/4	Mogul	8	IV								

### MILL TYPE MAZDA B LAMPS

#### 110,115 and 120 Volts

#### 220, 230, 240 and 250 Volts

Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Std. Pkg. Quantity	Consignment Classification	Size of Lamp in Watts	Approx. Lumens	Type and Size of Bulb	Diam. Bulb, Inches	Max. Over All Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
25	210	P-19	2 3/8	3 1/4	Medium	60	II	50	410	P-19	2 3/8	3 1/4	Medium	120	II Spl.
50	450	P-19	2 3/8	3 1/4	Medium	60	II								

Lamps of voltages of 100 to 109, 121 to 130, 200 to 219 and 251 to 260 inclusive are not regularly carried in stock but may be obtained at the same list prices.

\*50 to 500 watt Mazda C lamps can be supplied in daylight blue bulbs; 100 to 1000 watt lamps in bowl-enameled bulbs.

†Orders for this lamp should specifically state if it is for use in other than pendent position.

‡The bulb of this lamp is tipless and is made of white glass. Also made in clear glass tipped bulb.

§White MAZDA lamp.

¶These lamps can also be supplied with bowl-enameled bulb.

Current Price Schedule Furnished On Request

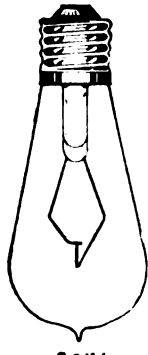
## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y.

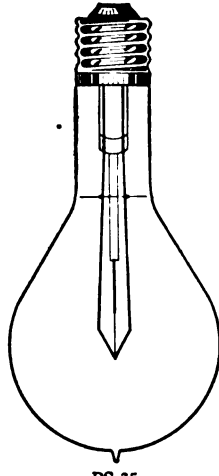
Sales Offices and Warehouses Throughout the United States



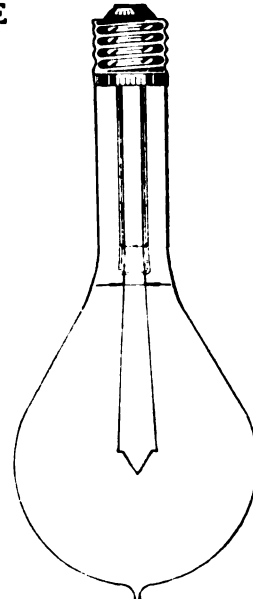
## WESTINGHOUSE MAZDA C LAMPS FOR STREET LIGHTING SERVICE



**S-24 1/2**  
60, 80 AND 100 C-P.  
6.6 AMP.



**PS-35**  
250 C-P.  
6.6 AMP.



**PS-40, 400 C-P. 15 AMP.**  
**AND 600 C-P. 20 AMP.**

The following lamps are for use on constant current circuits. Lamps of 15 and 20 amperes are ordinarily supplied from 6.6 ampere circuits with the use of a two-coil or auto-transformer for stepping up the current.

The prices of lamps for rectifier service, which are not included in the following, may be obtained on application.

MAZDA lamps for street series service selected for use on multiple compensators or for any other purpose where a single voltage or a range of voltages closer than standard are required will take a special price which may be obtained upon application.

Amperes	Nominal Rated Candle-Power	Total Lumens	Average Volts	Type and Size Bulb	Diam. Bulb, Inches	Light Center Length, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification						
6.6	60	600	6.7	S-24 1/2	3 1/8	5 3/8	7 1/8	Mogul	50	II-Spl.						
	80	800	8.4							II-Spl.						
	100	1000	10.0													
	250	2500	22.8							PS-35	4 3/8	7	9 3/4	Mogul	24	II-Spl.
	400	4000	36.8							PS-35	4 3/8	7	9 3/4	Mogul	24	II-Spl.
	600	6000	53.5	PS-40	5	7	10	Mogul	12	II-Spl.						
15.0	400	4000	14.7	*PS-40	5	9 1/4	12 1/8	Mogul	12	II-Spl.						
	600	6000	15.8	*PS-40	5	9 1/4	12 1/8	Mogul	12	II-Spl.						
20.0	1000	10000	25.9	*PS-40	5	9 1/4	12 1/8	Mogul	12	II-Spl.						
	1500	15000	38.1	*PS-40	5	9 1/4	12 1/8	Mogul	12	IV						
	2500	25000	60.6	*PS-52	6 1/2	9 1/2	13 1/8	Mogul	8	IV						

\*Orders for this lamp should specifically state if it is to be burned in other than pendent position.

### SPECIAL LIGHTING SERVICE—Street Series

Lamps are fitted with Mogul Screw Base unless otherwise noted

Nominal Candle Power	Lumens	Bulb	Diam. Bulb, Inches	Overall Length, Inches	AVERAGE VOLTS				Light Center Length, Inches	Std. Pkg. Quan.	Consignment Classification
					4.0 amp.	5.5 amp.	6.6 amp.	7.5 amp.			
<b>4, 5.5, 6.6 and 7.5 Amperes</b>											
32	320	S-24 1/2	3 1/8	7 1/8	6.8	5.2	4.4	3.8	5 3/8	50	IV
40	400	S-24 1/2	3 1/8	7 1/8	7.9	6.1	5.1	4.8	5 3/8	50	IV
60	600	S-24 1/2	3 1/8	7 1/8	10.7	8.0	...	6.2	5 3/8	50	II-Spl.
80	800	S-24 1/2	3 1/8	7 1/8	13.9	10.0	...	7.5	5 3/8	50	II-Spl.
100	1000	S-24 1/2	3 1/8	7 1/8	16.5	11.8	...	8.9	5 3/8	50	II-Spl.
<b>4, 5.5 and 7.5 Amperes</b>											
250	2500	PS-35	4 3/8	9 1/8	40.1	27.1	...	20.7	7	24	IV
400	4000	PS-35	4 3/8	9 1/8	63.7	44.1	...	29.6	7	24	IV
600	6000	PS-40	5	10 1/8	...	...	...	44.0	7	12	IV
<b>4 Ampere Rectifier</b>											
60	600	S-24 1/2	3 1/8	7 1/8	14.8*	15.4**	...	...	...	50	IV
80	800	S-35	4 3/8	8 1/8	19.3*	20.1**	...	...	...	24	IV
100	1000	S-35	4 3/8	8 1/8	23.7*	24.6**	...	...	...	24	IV
250	2500	S-40	5	10 1/8	57.7*	59.8**	...	...	...	12	IV
400	4000	G-56	7	11 1/8	91.4*	94.7**	...	...	...	8	IV

†These lamps fitted with skirted Mogul Screw Base.

\*Average Volts for G. E. Rectifier.

\*\*Average Volts for Westinghouse Rectifier.

Orders must specify whether for operation on G. E. or Westinghouse Rectifier Circuits.

Current Price Schedule Furnished On Request

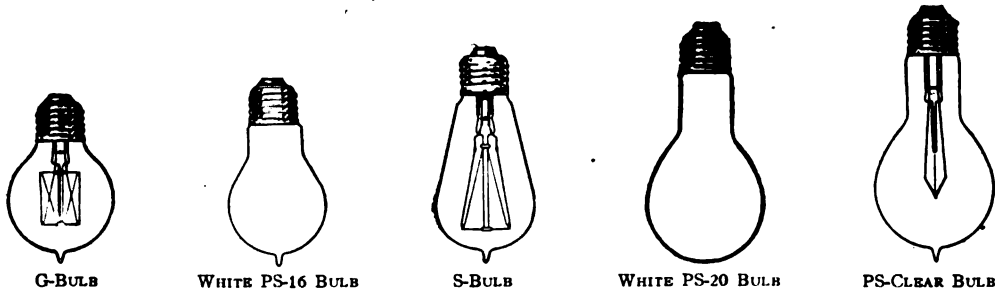
### WESTINGHOUSE LAMP COMPANY

185 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the United States

# WESTINGHOUSE MAZDA LAMPS

FOR USE WITH COUNTRY HOME LIGHTING OUTFITS



These lamps are generally used on the circuits of country home lighting outfits having 16 cells of acid (lead storage) battery or 24 cells of alkaline battery in connection with a generator. The capacity of country home lighting outfits is

usually expressed in number of 20-watt lamps which it will light without overloading batteries and generator. Thus a 50-lamp country home lighting outfit will light fifty 20-watt lamps or twenty-five 40-watt lamps, etc.

### 28—32 VOLT MAZDA B LAMPS

Watts (Nominal)	Approx. Lumens	Type and Size Bulb	Diam. Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
5	45	G-14	1 1/4	4 3/4	Med.	200	IV
10	97	G-17	2 1/4	5 3/4	Med.	120	I-Spl.
15	154	G-17	2 3/4	5 3/4	Med.	120	II-Spl.
20	208	G-17	2 3/4	5 3/4	Med.	120	II-Spl.
20	196	G-18 1/2	2 3/4	5 3/4	Med.	120	I-Spl.
25	270	G-17	2 3/4	5 3/4	Med.	60	IV
40	436	G-19	2 3/4	3 7/8	Med.	120	I-Spl.

### 28—32 VOLT MAZDA C LAMPS

Watts	Approx. Lumens	Type and Size Bulb	Diameter Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
15	151	*PS-16	2	4 1/4	Medium	120	IV
25	305	*PS-16	2	4 1/4	Medium	120	II-Spl.
50	640	†PS-20	2 1/2	5 1/4	Medium	60	I-Spl.
50	740	PS-20	2 1/2	5 1/4	Medium	60	I-Spl.
75	1215	PS-22	2 3/4	6 1/4	Medium	60	II-Spl.
100	1700	PS-25	3 1/4	7 1/4	Medium	24	II-Spl.

\*Whitecoated tipped bulb.  
†Whitecoated tipless bulb.

## FOR SIGN LIGHTING SERVICE

### STRAIGHT SIDE MAZDA B LAMPS

Volts	Size of Lamp in Watts	Approx. Lumens	Type and Size Bulb	Diameter Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
11*	5	45	S-14	1 3/4	4 3/4	Med.	200	II-Spl.
11 1/2*								
12								
55*	5	38	S-14	1 3/4	4 3/4	Med.	200	II-Spl.
60†								
110								
115	10	73	S-14	1 3/4	4 1/4	Med.	200	I-Spl.
120†								
	25		†P-19	2 3/4	3 1/4	Med.	120	I-Spl.
	50		†P-19	2 3/4	3 1/4	Med.	120	I-Spl.

\*The bulb is of special light blue glass to give a whiter light than the ordinary clear bulb lamp.

Sign lamps are divided into three groups as follows:

#### 11, 11 1/2 and 12 VOLTS

On alternating current circuits these lamps are generally operated on a transformer circuit where the voltage is reduced from 110, 115 or 120 to 11, 11 1/2 or 12 volts.

On direct current these lamps may be burned, ten in series on the 110, 115 or 120-volt circuit.

#### 55 AND 60 VOLTS

These lamps are generally burned two in series or in series multiple on 110, 115 or 120 volt circuit.

#### 110, 115 AND 120 VOLTS

These lamps are for use on regular multiple or ordinary lighting circuits.

\*Lamps of voltages of 10, 10 1/2 and 13 are not regularly carried in stock but may be obtained at the same list prices.

†Lamps of voltages of 50 to 54 inclusive are not regularly carried in stock but may be obtained at the same list prices.

‡Lamps of voltages of 100 to 109 and 126 to 130 inclusive are not regularly carried in stock but may be obtained at the same prices.

Current Price Schedule Furnished On Request

## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y.

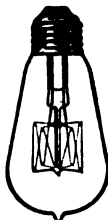
Sales Offices and Warehouses Throughout the United States

# WESTINGHOUSE MAZDA LAMPS

## TRAIN LIGHTING 30 TO 34 VOLTS



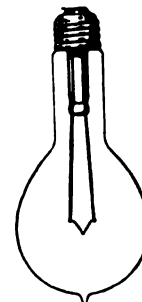
S-17 BULB



TS-17 BULB



G BULB



PS-CLEAR BULB

Orders should specify the individual voltage and be marked "Train Lighting" to distinguish from country home lighting lamp.

Lumens	Labeled Watts (Nominal)	Type and Size Bulb	Diameter Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification	Lumens	Labeled Watts (Nominal)	Type and Size Bulb	Diameter Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
<b>STRAIGHT SIDE MAZDA B LAMPS</b>								<b>ROUND MAZDA B LAMPS</b>							
97	10	S-17	2 1/4	5 1/2	Med.	120	II-Spl.	92	10	G-18 1/2	2 1/4	3 1/4	Med.	60	IV
154	15	S-17	2 1/4	5 1/2	Med.	120	IV	145	15	G-18 1/2	2 1/4	3 1/4	Med.	60	II-Spl.
208	20	S-17	2 1/4	5 1/2	Med.	120	IV	196	20	G-18 1/2	2 1/4	3 1/4	Med.	60	IV
1116	15	S-17	2 1/4	5 1/2	Med.	120	II-Spl.	245	25	G-18 1/2	2 1/4	3 1/4	Med.	60	II-Spl.
270	25	S-17	2 1/4	5 1/2	Med.	120	II-Spl.	560	50	G-30	3 1/2	6 1/2	Med. sk.	24	IV
560	50	S-19	2 1/4	5 1/2	Med.	120	IV								

<b>PEAR-SHAPE MAZDA C LAMPS</b>								<b>ROUND MAZDA C LAMPS FOR LOCOMOTIVE HEADLIGHT SERVICE</b>							
740	50	PS-20	2 1/4	5 1/2	Med.	60	III-Spl.	1590	100	*G-25	3 1/4	5 1/4	Medium	60	III-Spl.
1215	75	PS-22	2 1/4	6 1/2	Med.	60	III-Spl.	2550	150	*G-25	3 1/4	5 1/4	Medium	60	IV
1700	100	PS-25	3 3/8	7 1/2	Med.	24	III-Spl.	4600	250	*G-30	3 3/8	5 1/2	Medium	24	III-Spl.
151	15	PS-16	2	4 1/2	Med.	120	IV								
305	25	PS-16	2	4 1/2	Med.	120	III-Spl.								
640	50	PS-20	2 1/4	5 1/2	Med.	60	IV								

\*Light center length 3 inches.  
 †Can be burned in any position except within 45 degrees of vertically, base up.  
 ‡White coated tipped bulb.  
 ††White coated tipless bulb.  
 ‡‡33 volts only. For locomotive cab lighting service. Orders should so specify.

## FOR ELECTRIC RAILWAY SERVICE

Nominal Watts	Approx. Lumens	Type and Size Bulb	Diameter Bulb, Inches	Maximum Overall Length, Inches	Screw Base Regularly Supplied	Standard Package Quantity	Consignment Classification
<b>STRAIGHT SIDE MAZDA B LAMPS</b>							
23	224	S-17	2 1/4	5 1/2	Med.	120	II-Spl.
36	382	S-19	2 1/4	5 1/2	Med.	120	II-Spl.
56	591	S-21	2 1/4	5 1/2	Med.	120	II-Spl.
94	1032	S-24 1/2	3 1/4	7 1/2	Med.	50	III-Spl.
<b>ROUND MAZDA B LAMPS FOR HEADLIGHTS</b>							
23	194	G-18 1/2	2 1/4	3 1/4	Med.	60	III-Spl.
36	326	G-18 1/2	2 1/4	3 1/4	Med.	60	II-Spl.
46	418	G-25	3 3/8	4 1/4	Med.	60	IV
56	513	G-25	3 3/8	4 1/4	Med.	60	IV
94	883	G-25	3 3/8	4 1/4	Med.	60	II-Spl.

\*Light center length 2 1/4 in.  
 †Light center length 2 1/2 in.

These MAZDA lamps are selected for amperes and labeled for use five in series on the 525, 550, 575, 600, 625 and 650 volt circuits ordinarily used by electric street railway companies.

As considerable voltage fluctuation is sometimes found in this class of circuits, these lamps are manufactured only for six-voltage groups and care should be taken to see that the voltage group of lamps supplied corresponds closely to the average voltage found on the circuit.

Only the above lamps which are selected for amperes and for one-fifth the voltage on which they are labeled for use in series will be supplied at these prices.

†For lamps used 5 in series on 575 volts. The lumens for other lamps are in proportion to the volts.

Current Price Schedule Furnished On Request

## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the United States

# WESTINGHOUSE MAZDA LAMPS

## GENERAL LIGHTING SERVICE

110, 115 and 120 Volts  
CLEAR TUBULAR BULBS

Watts	Lumens	Bulb	Bulb Diam.	Max. Length	Screw Base	Std. Pkg.	Consignment Classification
25	245	T-10	1 1/4	6	Medium	100	II
40	345	T-8	1	12 1/4	Medium	50	IV

## SPECIAL LIGHTING SERVICE

### TRAIN LIGHTING

60 to 65 Volts

Watts	Lumens	Bulb	Bulb Diam. In.	Overall Length In.	Screw Base	Std. Pkg. Quantity	Consignment Classification
<b>MAZDA B LAMPS</b>							
15	144	S-17	2 1/8	5 1/4	Medium	120	III-Spl.
25	250	S-17	2 1/8	5 1/4	Medium	120	III-Spl.
50	530	S-19	2 3/8	5 1/4	Medium	120	IV
15	133	G-18 1/2	2 1/4	3 1/4	Medium	60	III-Spl.
25	235	G-18 1/2	2 1/4	3 1/4	Medium	60	III-Spl.
50	535	G-30	3 3/4	6 1/4	Medium Sk.	24	IV
<b>MAZDA C LAMPS</b>							
75	1005	PS-22	2 3/4	6 1/4	Medium	60	III-Spl.
100	1460	PS-25	3 3/8	7 1/4	Medium	24	III-Spl.

## SPECIAL LIGHTING SERVICE

Volts	Amp.	Watts	Lumens	Bulb	Screw Base	Light Center Length In.	Bulb Diam. In.	Max. Overall Lgth. In.	Std. Pkg. Quan.	Consignment Classification	Note
<b>PROJECTION</b>											
28-32	..	300	6870	T-16	Med.	3	2	5 5/8	12	IV	} Monoplane Filament. Must burn tip up.  } These lamps must burn tip up.  } Orders must specify that lamps are for projection purposes. Can be burned in any position except within 45 degrees of tip down.
28-32	20	600	15600	T-20	Mogul	4 1/4	2 1/2	9 1/2	6	I-Spl.	
28-32	30	900	23580	T-20	Mogul	4 3/4	2 1/2	9 1/2	6	I-Spl.	
110, 115 and 120	..	250	4825	T-14	Med.	3	1 1/2	5 5/8	24	I-Spl.	
110, 115 and 120	..	400	8840	T-20	Med.	3	2 1/4	5 5/8	6	I-Spl.	
110, 115 and 120	..	400	8840	T-20	Med. Sk.	3 3/8	2 1/2	6 1/2	6	I-Spl.	
110, 115 and 120	..	1000	24100	T-20	Mogul	4 3/4	2 1/2	9 1/2	6	III-Spl.	
110, 115 and 120	..	100	1410	G-25	Med.	3	3 3/8	5 5/8	60	I-Spl.	
110, 115 and 120	..	250	4550	G-30	Med.	3	3 3/8	5 5/8	24	III-Spl.	
110, 115 and 120	..	250	4550	G-30	Mogul	3 3/8	3 3/8	5 5/8	24	III-Spl.	
110, 115 and 120	..	400	8320	G-30	Med.	3	3 3/4	5 5/8	24	III-Spl.	
110, 115 and 120	..	400	8320	G-30	Med. Sk.	3 3/8	3 3/4	6 1/4	24	III-Spl.	
<b>FLOOD LIGHTING</b>											
110, 115 and 120	..	250	3250	G-30	Med.	3	3 3/4	5 5/8	24	II-Spl.	} Orders must specify that lamps are for Floodlighting purposes. Can be burned in any position except within 45 degrees of tip down.
110, 115 and 120	..	250	3250	G-30	Mogul	3 3/8	3 3/4	5 5/8	24	II-Spl.	
110, 115 and 120	..	500	8100	G-40	Mogul	4 1/4	5	7 3/8	12	II-Spl.	
<b>MINE LIGHTING</b>											
275	..	50	.....	P-19	Med.	..	2 3/8	3 1/4	120	II-Spl.	
275	..	100	.....	S-30	Med.	..	3 3/4	8	24	II-Spl.	

Current Price Schedule Furnished On Request

## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the United States

## WESTINGHOUSE MAZDA DECORATIVE LAMPS

### GENERAL LIGHTING SERVICE

110, 115 and 120 Volts



B-BULB



T-BULB



G-BULB



D-BULB

Watts	Nominal Lumens	Bulb	Bulb Diam. In.	Maximum Overall Length. In.	Screw Base	Pkg. Quantity	Consignment Classification
<b>All-frosted Mazda B Lamps</b>							
15	100	B-9½	1⅞	3¾	Candelabra	100	IV
15	100	G-16½	2⅞	3¾	Candelabra	100	III
15	100	D-10	1¼	3¾	Candelabra	100	III
<b>Clear Mazda B Lamps</b>							
15	110	G-9½	1⅞	3¾	Candelabra	100	IV
15	110	G-16½	2⅞	3¾	Candelabra	100	IV
15	110	D-10	1¼	3¾	Candelabra	100	IV
15	110	T-8	1	3¾	Candelabra	100	IV

### CLEAR ROUND BULB LAMPS

110, 115 and 120 Volts

15	126	G-18½	2⅞	3⅞	Medium	60	IV
15	132	G-25	3¾	4⅞	Medium	60	IV
25	227	G-18½	2⅞	3⅞	Medium	60	III
25	250	G-25	3¾	4⅞	Medium	60	III
40	420	G-25	3¾	4⅞	Medium	60	IV

## WESTINGHOUSE MAZDA FLASHLIGHT LAMPS



MAZDA 1 AND 2  
FE3¾ BULB  
⅞" DIAM.



MAZDA 11  
G-3¾ BULB,  
⅞" DIAM.



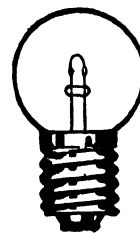
MAZDA 16 AND 17  
G-4¾ BULB,  
⅞" DIAM.



MAZDA 19  
G-4¾ BULB,  
⅞" DIAM.



MAZDA 31  
G-5¾ BULB,  
⅞" DIAM.



MAZDA 35  
G-5¾ BULB,  
⅞" DIAM.

#### FOR TWO-CELL FLASHLIGHT BATTERIES

Mazda No.	Volts	Amp.	Bulb	Base	Finish
1	2.2	0.25	FE3¾	Min.	Clear
11	2.3	0.27	G-3¾	Min.	Clear
16	2.5	0.30	G-4¾	Min.	Clear

#### FOR THREE-CELL FLASHLIGHT BATTERIES

2	3.3	0.25	FE3¾	Min.	Clear
17	3.8	0.30	G-4¾	Min.	Clear
*13	3.8	0.30	G-3¾	Min.	Clear

#### FOR FIVE-CELL FLASHLIGHT BATTERIES

Mazda No.	Volts	Amp.	Bulb	Base	Finish
31	6.2	0.30	G-5¾	Min.	Clear

#### FOR ONE-CELL STANDARD DRY BATTERY

19	1.25	0.60	G-4¾	Min.	Clear
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#### FOR TWO CELLS OF STANDARD DRY BATTERY

35	2.4	0.80	G-5¾	Min.	Clear
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\*Concentrated filament for focusing flashlights only.

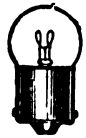
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### WESTINGHOUSE LAMP COMPANY

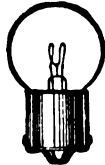
165 Broadway, New York, N. Y.

Sales Offices and Warehouses Throughout the United States

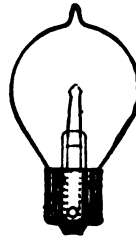
# WESTINGHOUSE MAZDA AUTOMOBILE LAMPS



MAZDA 63  
G-6 BULB



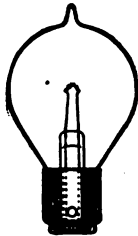
MAZDA 81  
G-8 BULB



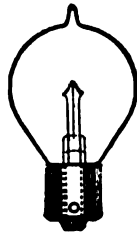
MAZDA 1129  
S-11 BULB



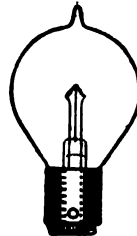
BAYONET  
CANDELABRA BASE  
(SINGLE CONTACT)



MAZDA 1130  
S-11 BULB



MAZDA 1139  
S-11 BULB



MAZDA 1141  
S-11 BULB



BAYONET  
CANDELABRA BASE  
(DOUBLE CONTACT)

## LAMPS FOR 3-CELL (LEAD TYPE) STORAGE BATTERY— GENERATOR LIGHTING SYSTEMS (6-8 VOLTS)

Description	MAZDA NO.		RATINGS APPEARING ON LAMPS		Type and Size Bulb	Diam. Bulb, In.	Max. Overall Length, In.	Unit Package Quantity
	S.C. Base	D.C. Base	Volts	Candle Power				
Rear and Speedometer (2 in series)	Mazda 61	Mazda 62	3- 4	2	G- 6	3/4	1 3/8	10
Rear and Speedometer	Mazda 63	Mazda 64	6- 8	2	G- 6	3/4	1 3/8	10
Side and Auxiliary Headlight	Mazda 81	Mazda 82	6- 8	4	G- 8	1	1 3/4	10
Mazda C Headlight and Spotlight	Mazda 1129	Mazda 1130	6- 8	21	S-11	1 3/8	2 1/2	10

## LAMPS FOR FORD CARS

*Mazda C Headlamp	.....	Mazda 1130	6- 8	21	S-11	1 3/8	2 1/2	10
†Mazda C Headlamp	.....	Mazda 1158	6- 8	21-3	S-11	1 3/8	2 1/2	10
‡Mazda C Headlamp	.....	Mazda 1160	9	21	S-11	1 3/8	2 1/2	10
§Mazda B Rear Inst. & Aux. Head	Mazda 63	.....	6- 8	2	G-6	3/4	1 3/8	10
¶Mazda C Headlamp	Mazda 1129	.....	6- 8	21	S-11	1 3/8	2 1/2	10

\*6-8-volt lamps, to be burned two in series on magneto lighting system, equipped with reactance coil. To insure satisfactory service see that two Mazda 1130 lamps are operated in series.

†For 3-cell, lead storage battery generator lighting system.

‡To be burned two in series on Magneto lighting system not equipped with reactance coil. For use on Ford cars wired for two filament lamps.

§6-8-volt lamps for cars equipped with 3-cell (lead type) storage battery generator lighting system.

## LAMPS FOR 6-CELL (LEAD TYPE) STORAGE BATTERY— GENERATOR LIGHTING SYSTEM (12-16 VOLTS)

Rear and Speedometer (2 in series)	Mazda 63	Mazda 61	6- 8	2	G- 6	3/4	1 3/8	10
Rear and Speedometer	Mazda 67	Mazda 68	12-16	2	G- 6	3/4	1 3/8	10
Mazda C Headlight and Spotlight	Mazda 1141	Mazda 1142	12-16	21	S-11	1 3/8	2 1/2	10

## WESTINGHOUSE MAZDA LAMPS FOR MOTORCYCLE SERVICE

Rear Light	Mazda 63	.....	6-8	2	G- 6	3/4	1 3/8	10
Mazda C Headlight and Spotlight	Mazda 1129	.....	6-8	21	S-11	1 3/8	2 1/2	10

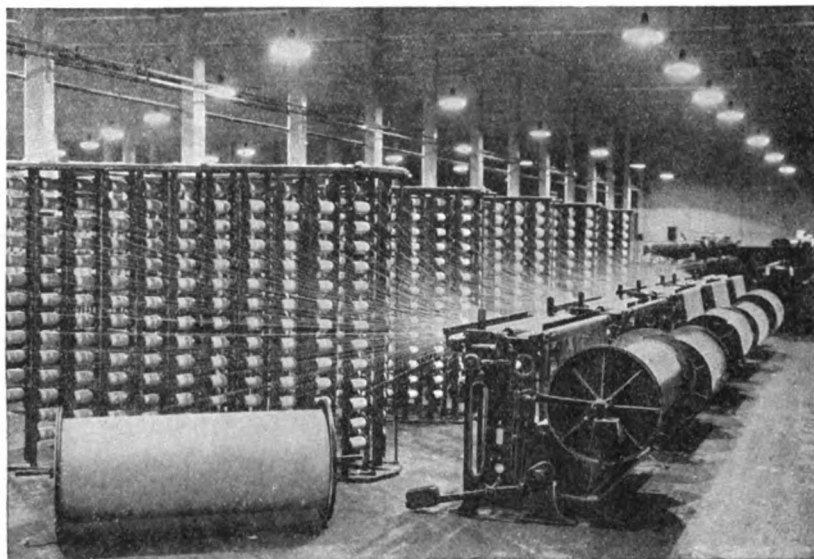
Current Price Schedule Furnished On Request

## WESTINGHOUSE LAMP COMPANY

165 Broadway, New York, N. Y

Sales Offices and Warehouses Throughout the United States

## INDUSTRIAL LIGHTING



### ADVANTAGES OF GOOD LIGHTING

It is conceded that proper industrial lighting is responsible for:

1. Increased production for the same labor cost.
2. Greater accuracy in workmanship.
3. Decrease in spoilage.
4. Reduction of accidents.
5. Improved order and cleanliness in the plant.
6. Easier supervision of men.
7. Better working and living conditions.
8. Less eye strain and physical fatigue.

9. Greater contentment of men, reducing labor turn-over.

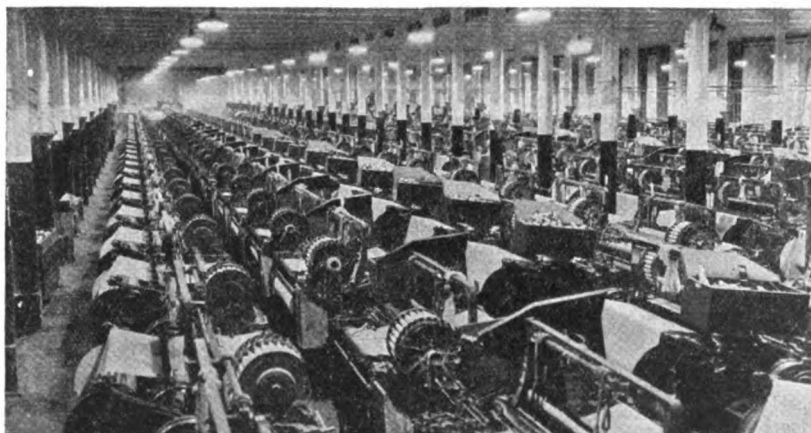
Present day conditions are forcing all industrial plants to realize the necessity for good lighting. The demands for better working conditions, the great losses of high-priced material spoiled, and the urgency of filling orders on schedule time make it necessary for every industrial plant to have improved lighting equipment.

### DESIGNING GOOD LIGHTING

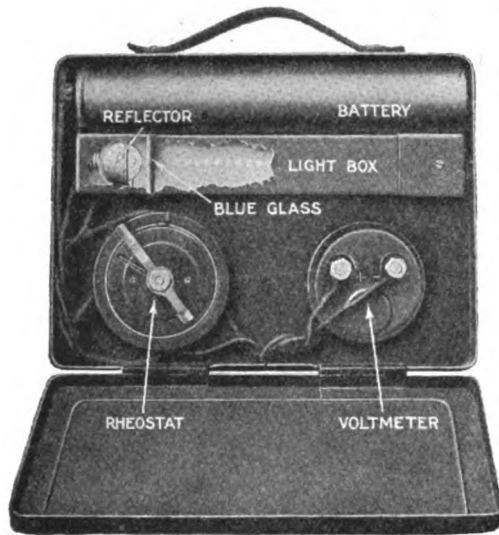
Not so many years ago lighting problems were often treated by the "Cut and Try" method. The importance of efficient reflectors was hardly recognized and glare was considered as an indication of an abundance of light. Present day lighting design is carried out on an entirely different basis. First of all we recognize that these three fundamental requirements must be established:

1. Light of sufficient intensity.
2. Light from the proper direction.
3. Light of suitable qualities.

Obviously the ideal design for factory lighting is one enabling the workmen to perform their duties with the greatest accuracy and speed and with the least eye strain. To be practical, the system should be flexible in operation and moderate in first cost as well as in maintenance.



## THE FOOT-CANDLE METER



INTERIOR VIEW OF FOOT-CANDLE METER



FOOT-CANDLE METER

The foot-candle meter is a light portable instrument with which one may determine the intensity of illumination at any point. It is simple in construction and not easily damaged. Readings are made directly in foot-candles. No mathematical calculations are needed to make the readings significant.

The foot-candle meter shows whether the lighting is or is not adequate. It further enables one to know

definitely whether the illumination is uniform. If the light in a room is not evenly distributed, the meter will show such a condition at a glance.

**Weight**—Meter only, 3 pounds; packed for shipment, 7 pounds.

**Size of Meter**— $7\frac{1}{8} \times 6 \times 1\frac{1}{2}$  inches.

**Price**—Complete with carrying case, \$25.00.

**Recalibration Charge**—\$1.00.

These prices are net, f.o.b. Bloomfield, N. J.

### The Westinghouse Illuminating Engineering Bureau

In the past, lighting problems have too often been handled in a hit or miss manner and the vital importance of the subject has not been realized. The Westinghouse Company has established an Illuminating Engineering Bureau to co-operate in the movement for improved lighting and to assist

industrial executives, architects and others with their lighting problems. Under the guidance of this Bureau guess work is eliminated and the most efficient method of lighting assured.

To obtain the assistance of this Bureau notify the nearest Westinghouse office.

### Overall heights of type C lamps in different fixtures

Watts	Base	Bulb	OVERALL HEIGHT INCHES*			Light Center Length, Inches	Overall Lamp Length Inches		
			TYPE OF REFLECTOR	SOCKET	FIXTURE ANGLE				
75	Medium	PS-22	RLM Dome	Bowl-Type	7 $\frac{1}{8}$	8 $\frac{1}{8}$	11 $\frac{1}{8}$	4 $\frac{1}{8}$	6 $\frac{1}{8}$
100	Medium	PS-25	9	9 $\frac{1}{8}$	11 $\frac{1}{8}$	5 $\frac{1}{8}$	7 $\frac{1}{8}$	7 $\frac{1}{8}$	7 $\frac{1}{8}$
150	Medium	PS-25	9	9 $\frac{1}{8}$	11 $\frac{1}{8}$	5 $\frac{1}{8}$	7 $\frac{1}{8}$	7 $\frac{1}{8}$	7 $\frac{1}{8}$
200	Medium	PS-30	10 $\frac{3}{8}$	11	11 $\frac{1}{8}$	6	8 $\frac{3}{8}$	8 $\frac{3}{8}$	8 $\frac{3}{8}$
300	Mogul	PS-35	11 $\frac{1}{8}$	12 $\frac{1}{8}$	15 $\frac{1}{8}$	7	9 $\frac{1}{8}$	9 $\frac{1}{8}$	9 $\frac{1}{8}$
500	Mogul	PS-40	11 $\frac{1}{8}$	12 $\frac{1}{8}$	15 $\frac{1}{8}$	7	10	10	10
750	Mogul	PS-52	15 $\frac{1}{8}$	15 $\frac{1}{8}$	19 $\frac{1}{8}$	9 $\frac{1}{2}$	13 $\frac{1}{8}$	13 $\frac{1}{8}$	13 $\frac{1}{8}$
1000	Mogul	PS-52	15 $\frac{1}{8}$	15 $\frac{1}{8}$	19 $\frac{1}{8}$	9 $\frac{1}{2}$	13 $\frac{1}{8}$	13 $\frac{1}{8}$	13 $\frac{1}{8}$

\*These dimensions are overall height from top of fixture to lowest point of reflector or lamp tip and may be used in determining overhead room needed or crane clearances, etc.

For prices and other lamp data consult Westinghouse Lamp Co., nearest District Office.

### Key to Reflector Style Numbers

Style numbers for reflectors consist of six digits. The following table is a guide:

<b>FIRST DIGIT</b> INDICATES FINISH	<b>SECOND DIGIT</b> INDICATES HOLDER	<b>THIRD DIGIT</b> INDICATES TYPE	<b>FOURTH, FIFTH AND SIXTH DIGITS INDICATE</b> SIZE OF LAMP
2 = Enamel Aluminum	0 = One piece Reflectors only for use with Reflector Sockets	3 = Shallow Dome	040 = 40 Watt
3 = Porcelain Enamel	1 = Snap Ring Holder	4 = Angle Type	060 = 60 Watt
	2 = 2 $\frac{1}{4}$ -inch Heel	5 = Focusing	075 = 75 Watt
	3 = 3 $\frac{1}{4}$ -inch Heel	6 = R L M Standard Dome	150 = 100-150 Watt
		7 = Standard Bowl	200 = 200 Watt
		8 = Flat Cone	500 = 300-400-500 Watt
			000 = 750-1000 Watt

Example 326075; 3, porcelain enamel, 2, 2 $\frac{1}{4}$ -inch standard heel; 6, R L M Standard Dome; 075, 75 watt Type C lamp.

Order by Style Number



## REFLECTOR-SOCKET-FIXTURES

"Easy to Wire"—Guaranteed Weather-Proof



Westinghouse Reflector-socket-Fixtures consist of one-piece porcelain enameled steel reflectors and reflector-sockets. The reflectors are fastened securely to the porcelain body of the reflector-sockets with fibre gaskets between the reflector heel and the porcelain seat and with copper washers within the reflector neck, making the fixture waterproof and protecting the enamel.

This design offers a compact rigid assembly and at the same time retains the "Easy-to-Wire"

features so well known to users of Westinghouse Reflector Sockets.

Reflector-socket-Fixtures are easy to wire. One complete fixture can be installed by one man in three minutes. Only a few operations are necessary. With the Reflector-socket-Fixture for attachment to outlet-box, the wires are pulled through the vertical openings in the porcelain socket and connected to the terminals. The reflector is then fastened to the socket by means of three screws which engage in bayonet slots in the top of the reflector. Reflector-socket-Fixtures may be attached to conduit in a similar manner. In either case there

are no loose wires to stuff back or washers and lock nuts to adjust. Reflector-socket-Fixtures are waterproof and have cast iron covers heavily galvanized and painted. They will not corrode. The reflectors are insulated from the conduit and the terminals are protected from accidental short circuit.

The assembly of Reflector-socket-Fixtures is such that the reflector is sure to seat in its correct position with respect to the lamp filament, thereby assuring the most efficient distribution of light from each of the different types.

Reflector-socket-Fixtures insure permanent high efficiency. They are well protected from dust accumulation and the reflectors are easily cleaned.

Reflector-socket-Fixtures are interchangeable. Reflectors of different types may be substituted at any time and reflectors for medium base and mogul base lamps may be interchanged respectively with medium screw and mogul screw sockets. All Reflector-socket-Fixtures are equipped with a double lamp grip which insures a perfect electrical contact and prevents the loosening of lamps under vibration.



**Methods of Attachments**—Reflector-socket-Fixtures may be used on any type of installation and for either interior or exterior lighting purposes. They may be suspended:

1. On  $\frac{1}{2}$ -inch or  $\frac{3}{4}$ -inch conduit.
2. Directly from the outlet-box or conduit.
3. On chain or cord by using suspension eyes.
4. On reinforced drop cord, by using porcelain bushings.

**Approved Construction**—Westinghouse Reflector-Sockets are approved by the National Board of Fire Underwriters.

## REFLECTOR-SOCKETS FOR BAYONET-HEEL REFLECTORS

Reflector sockets for the type of reflectors described on the previous page are made in two sizes, medium screw and mogul. Each size is furnished in four styles, for 1/2-inch conduit, for 3/4-inch conduit, for 4-inch outlet box and conduit as shown below.



FOR CONDUIT



FOR OUTLET BOXES OR CONDULETS

Medium base reflector-sockets are interchangeable with all reflectors rated for 200-watt or smaller lamps, and mogul base reflector-sockets are interchangeable with all reflectors rated for 300-watt or larger lamps.

Reflector sockets are contained in individual cartons packed in **standard packages of ten.**

STYLE NUMBERS				Lamp base	Std. Pkg. Weight Lbs.	List Price Each
For 1/2-inch conduit	For 3/4-inch conduit	With 4-inch outlet box cover	With cover for conduit†			
336387	336388	336389	336390	Medium	14	\$1 30
336391	336392	336393	336394	Mogul	22	1 95

†Furnished with cover for Crouse-Hinds Condulets, series LO, CL, BO, BLM, DSO and DSP. Specify type of Condulet when ordering.

## REFLECTOR SOCKETS FOR STANDARD HEEL REFLECTORS



Reflector sockets for standard heel reflectors embody all the advantages found in reflector sockets for Bayonet-heel reflectors. They have the "Easy to Wire," interchangeable and weatherproof features.

These reflector sockets are offered as the most efficient and permanent means of supporting reflectors having 2 1/4 inch or 3 1/4 inch standard heels.



FOR CONDULET OR BOXES

### 2 1/4-INCH REFLECTOR-SOCKETS With Keyless Porcelain Medium Screw Sockets

Style No.	Description	STANDARD	PKG.	List Price
		Amt.	Wt., Lbs.	Each
336215	For 1/2-inch conduit attachment	10	30	\$1 60
336398	For 3/4-inch conduit.....	10	30	1 60
336319	With 4-inch outlet box cover....	10	25	1 60
336400	With cover for Crouse-Hinds Condulet†.....	10	25	1 60

### 3 1/4-INCH REFLECTOR-SOCKETS With Keyless Porcelain Mogul Screw Sockets

Style No.	Description	STANDARD	PKG.	List Price
		Amt.	Wt., Lbs.	Each
336219	For 1/2-inch conduit attachment.	10	35	\$2 25
336402	For 3/4-inch conduit.....	10	35	2 25
336320	With 4-inch outlet box cover....	10	30	2 25
336404	With cover for Crouse-Hinds Condulet†.....	10	30	2 25

†Furnished with cover for Crouse-Hinds Condulets, series LO, CL, BO, BLM, DSO and DSP. Specify type of Condulet when ordering.



When it is desired to suspend fixtures on drop cords porcelain bushings may be used with reflector sockets.

Description	Style No.	FOR SOCKETS STYLE NUMBERS				Package Quantity	List Price Each
		336387	336391	336215	336219		
1/2-inch Bushing	346002					100	\$0 10

Order by Style Number

## SHURLOCK REFLECTOR SOCKETS

This fixture is an adaptation of the Pass & Seymour Company's Shurlock socket. It is assembled within a cast iron cap, which serves as the holder for any type Bayonet-heel reflector for 200-watt or smaller lamps. This line has been developed to extend the desirable features of Reflector-Socket-Fixtures to meet the requirements when lock-sockets are desired, thereby providing complete interchangeability in an installation consisting of both lock-sockets and standard reflector-sockets.



STYLE NUMBERS OF SHURLOCK-REFLECTOR-SOCKETS WITHOUT REFLECTOR  
 For 1/2-in. Conduit **338048**  
 For 4-in. Outlet Box **348008**

Lamp Base  
 Med. screw base

STANDARD PACKAGE  
 Quantity **10**  
 Weight Lbs. **15**

List Price Each **\$2 60**

In ordering complete fixtures specify style number of Shurlock-Reflector-Socket from the table above, and style number of reflector listed under "Bayonet-heel Reflectors." The price and weight of the complete fixture will be the sum of the price and weight of the socket and that of the reflector.

For Pass & Seymour Shurlock Key order Style No. 350696. Sold only with Shurlock Reflector Sockets at 35 cents each net regardless of quantity.

## PULL-CHAIN REFLECTOR SOCKETS

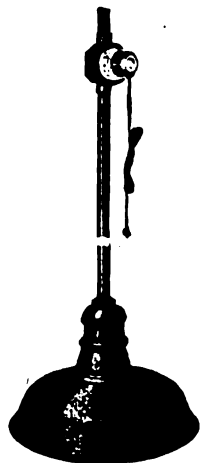
This fixture is for mounting direct to standard 4-inch outlet-boxes. It consists of a cast iron fitting on which is mounted a Bryant pull switch No. AY-19, a reflector-socket, and a 200 watt or smaller Bayonet-heel reflector. All the advantages of "Easy-to-Wire" Reflector-Sockets are retained in this fixture.

*Style No.	STANDARD PACKAGE	Price
Pull-Chain Reflector-Socket without Reflector	Quantity Wt., Lbs.	Each
<b>336524</b>	Med. Screw Base 10 45	<b>\$2 90</b>

\*Any of the following reflectors may be used in connection with this Pull-Chain Reflector-Socket: Style Nos. W306075, W306150, W306200, W307060, W307075, W307150, W307200, W304040, W304060, W304200, W309060, W309150.



When the pull chain feature is desired and it is not possible to mount fixtures direct on outlet boxes, the arrangement illustrated at the left is suggested using Reflector-Socket Style No. 336387 with desired Bayonet-heel reflector mounted on 1/2-inch conduit equipped with Crouse-Hinds G-151 Condulet or No. 7402 Type G Unilet and Bryant Pull Switch No. AY-19.



Style No. **353745**

Style No. **353744**

Style No. **353746**

## BRASS HOLDERS FOR STANDARD HEEL REFLECTORS

Standard Heel Reflectors can be securely mounted on brass or porcelain sockets by means of brass holders listed below.

Style No.		Standard Pkg.	List Price Each
<b>353744</b>	For threaded brass shell sockets . . .	10	<b>\$0 15</b>
<b>353745</b>	For beaded brass shell sockets.....	10	<b>15</b>
<b>353746</b>	For porcelain sockets.....	10	<b>15</b>

Order by Style Number

## STANDARD RLM DOME REFLECTORS

Westinghouse-Cutter RLM Standard Dome Reflectors are coated inside and out with porcelain enamel. The first coat is a binder coat after which one coat of green is applied outside and two coats of white inside. Each coat is fired separately. Each reflector bears the RLM label shown below, assuring the customer of the highest quality.

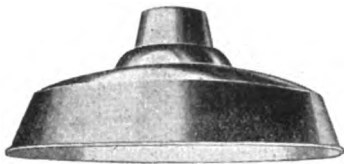
### RLM REFLECTORS FOR REFLECTOR-SOCKETS

The RLM Fixtures listed below are combinations of Bayonet-heel reflectors and reflector-sockets.

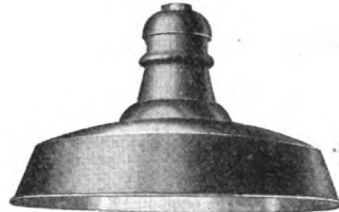
Prices are given for complete fixtures, and for Bayonet-heel reflectors only. In ordering complete fixtures specify style number of reflector-socket (see

Reflector-Sockets for Bayonet-heel Reflectors) and style number of reflector from following table.

For the purpose of determining discounts when ordering complete fixtures, use standard package quantity shown for reflectors only.



BAYONET-HEEL RLM REFLECTOR



COMPLETE RLM FIXTURE

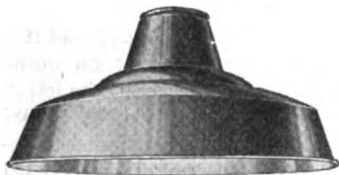
For Lamp Size Watts	Style Lamp Base	Style No.	BAYONET HEEL REFLECTORS ONLY			Price Each	List Price Complete Fixture
			Diameter Inches	STANDARD PACKAGE Quantity	Wt., Lbs.		
50	Medium	W308050	12 1/8	10	20	\$2 20	\$3 50
75	Medium	W308075	12 1/8	10	20	2 20	3 50
100-150	Medium	W308150	14 1/8	10	27	2 50	3 80
200	Medium	W308200	16 1/8	5	22	3 30	4 60
300-500	Mogul	W308500	18 1/8	5	30	3 75	5 70
750-1000	Mogul	W308000	20 1/8	3	30	5 75	7 70

\*Price of complete fixture includes Bayonet-heel reflector as listed and any reflector socket listed. In ordering give style number of each.

### RLM REFLECTORS WITH STANDARD HEEL—2 1/4 AND 3 1/4-INCH

One of the principal advantages of Standard-Heel reflectors is in equipping lamps where the sockets and wiring are already installed. The 2 1/4-inch heel is supplied on reflectors rated for 200-watt or smaller lamps, and the 3 1/4-inch heel on reflectors for 300-watt and larger lamps. Reflectors with

2 1/4-inch heel can be securely attached to brass shell or porcelain sockets by means of brass holders. The most lasting installation of Standard-Heel reflectors is obtained by supporting them from Reflector-Sockets. Reflector-Sockets should always be used with large reflectors having 3 1/4-inch heel.



RLM REFLECTOR WITH STANDARD HEEL

Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Amt.	Wt. Lbs.	List Price Each
W328050	50	12 1/8	5 1/4	10	20	\$2 00
W328075	75	12 1/8	5 1/4	10	20	2 00
W328150	100-150	14 1/8	6 1/4	10	27	2 40
W328200	200	16 1/8	7 1/4	5	22	2 75
W338500	300-400-500	18 1/8	8 1/4	5	30	3 85
W338000	750-1000	20 1/8	10 1/4	3	25	5 70

### RLM REFLECTORS WITH SNAP RING HOLDERS FOR BRASS SHELL SOCKETS

The snap-ring holder forms an easy and dependable method of attaching reflectors to brass-shell sockets.

Porcelain Enamel, White Interior, Green Exterior



RLM REFLECTOR WITH SNAP RING HOLDER

Style No.	For Lamp Size Watts	Diam. In.	Depth In.	STANDARD PACKAGE Quantity	Wt., Lbs.	List Price Each
W318050	50	12 1/8	5 3/8	10	20	\$2 15
W318075	75	12 1/8	5 3/8	10	20	2 15
W318150	100-150	14 1/8	6 3/8	10	27	2 55
W318200	200	16 1/8	8 3/8	5	22	2 90

### RLM CODE LABELS

All Westinghouse-Cutter Dome reflectors bear the code label certifying them to be in compliance with Reflector and Lamp Manufacturers' standard specifications. These specifications regulate the shape and workmanship, in which respects RLM reflectors must pass exacting tests by the Electrical Testing Laboratories before the use of this label is allowed.



## STANDARD BOWL REFLECTORS

### STANDARD BOWL REFLECTORS FOR REFLECTOR SOCKETS

Standard bowl fixtures listed below are combinations of Bayonet-heel reflectors and reflector-sockets.

Prices are given for complete fixtures, and for Bayonet-heel reflectors only. In ordering complete fixtures specify style number of reflector-socket (see

"Reflector-Sockets for Bayonet-heel Reflectors") and style number of reflector from following table.

For the purpose of determining discounts when ordering complete fixtures, use standard package quantity shown for reflectors only.



BAYONET-HEEL REFLECTOR



COMPLETE FIXTURE

For Lamp Size Watts	Style Lamp Base	BAYONET-HEEL REFLECTORS ONLY				List Price Each	*List Price Complete Fixture
		Style No.	Diameter Inches	STANDARD PACKAGE Quantity	PACKAGE Wt., Lbs.		
25-40-60	Medium	W307080	7 1/4	10	15	\$1 80	\$2 90
75	Medium	W307075	8 1/4	10	15	1 80	3 10
100-150	Medium	W307150	8 1/2	10	15	2 00	3 30
200	Medium	W307200	10 1/2	10	25	2 50	3 80
300-500	Mogul	W307500	12 3/4	10	30	2 75	4 70
750-1000	Mogul	W307000	15 1/2	3	30	4 55	6 60

\*Price of complete fixture includes Bayonet-heel reflector as listed and any reflector socket listed. In ordering give style number of each.

### BOWL REFLECTORS WITH STANDARD HEEL—2 1/4 AND 3 1/4-INCH

Standard heel reflectors may be attached to brass shell or porcelain sockets by means of the brass holders or to reflector sockets. The 2 1/4-inch heel is supplied on reflectors rated for 200-watt or smaller

lamps, and the 3 1/4-inch heel on reflectors for 300-watt and larger lamps. The reflector sockets should always be used with the large reflectors having 3 1/4-inch heel.



BOWL REFLECTOR WITH STANDARD HEEL

Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Quantity	PACKAGE Wt., Lbs.	List Price Each
<b>Porcelain Enamel, White Interior, Green Exterior</b>						
W327080	25-40-60	7 1/4	5	10	15	\$1 50
W327075	75	8 1/4	6 1/2	10	15	1 80
W327150	100-150	8 1/2	7 1/4	10	15	1 80
W327200	200	10 1/2	8 3/4	10	25	2 20
W337500	300-400-500	12 1/2	8 3/4	10	30	3 60
W337000	750-1000	15 1/4	11 3/8	5	30	4 35
<b>Enam-Aluminum Interior, Green Baked Paint Exterior</b>						
W227080	25-40-60	7 1/4	5	10	20	90
W227075	75	8 1/4	6 1/2	10	25	1 10
W227150	100-150	8 1/2	7	10	30	1 15
W227200	200	10 1/2	8 3/4	10	35	1 70

### BOWL REFLECTORS WITH SNAP RING HOLDERS, FOR BRASS SHELL SOCKETS

The snap-ring holder forms an easy and dependable method of attaching reflectors to brass-shell sockets.



BOWL REFLECTOR WITH SNAP RING HOLDER

Style No.	For Lamp Size	Diameter Inches	Depth In.	STANDARD PACKAGE Quantity	PACKAGE Wt., Lbs.	List Price Each
<b>Porcelain Enamel, White Interior, Green Exterior</b>						
W317080	25-40-60	7 1/4	5 3/4	10	15	\$1 65
W317075	75	8 1/4	6 1/2	10	15	1 75
W317150	100-150	8 1/2	7 3/8	10	15	1 95
W317200	200	10 1/2	8 3/4	10	25	2 35
<b>Enam-Aluminum Interior, Green Baked Paint Exterior</b>						
W217080	25-40-60	7 1/4	5 3/4	10	15	1 05
W217075	75	8 1/4	6 3/4	10	15	1 25
W217150	100-150	8 1/2	7 3/4	10	15	1 30
W217200	200	10 1/2	8 3/4	10	25	1 80

Order by Style Number

## STANDARD ANGLE REFLECTORS

### STANDARD ANGLE REFLECTORS FOR REFLECTOR-SOCKETS

Standard angle fixtures listed below are combinations of Bayonet-heel reflectors and reflector-sockets.

Prices are given for complete fixtures, and for Bayonet-heel reflectors only. In ordering complete fixtures specify style number of reflector-socket (see

"Reflector-Sockets for Bayonet-heel Reflectors") and style number of reflector from following table.

For the purpose of determining discounts when ordering complete fixtures, use standard package quantity shown for reflectors only.



BAYONET-HEEL REFLECTOR



COMPLETE FIXTURE

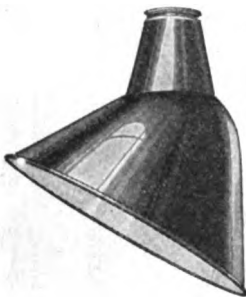
For Lamps Size Watts	Lamp Base	BAYONET-HEEL REFLECTORS ONLY				List Price Each	List *Price Complete Fixture
		Style No.	Diameter Inches	STANDARD PACKAGE Quantity	Wt., Lbs.		
25-40	Medium	W304040	6 3/8	10	15	\$1 30	\$2 60
60	Medium	W304060	8	10	15	1 90	3 20
75-150-200	Medium	W304200	10 1/2	10	15	2 90	4 20
300-500	Mogul	W304500	12 1/2	5	25	4 20	6 15
750-1000	Mogul	W304000	15 1/2	5	30	6 35	8 30

\*Price of complete fixture includes Bayonet-heel reflector as listed and any reflector socket listed. In ordering give style number of each.

### ANGLE REFLECTORS WITH STANDARD HEEL—2 1/4 AND 3 1/4-INCH

Standard heel reflectors may be attached to brass shell or porcelain sockets by means of the brass holders or to reflector-sockets. The 2 1/4-inch heel is supplied on reflectors rated for 200-watt or smaller

lamps, and the 3 1/4-inch heel on reflectors for 300-watt and larger lamps. The reflector-sockets should always be used with the large reflectors having 3 1/4-inch heel.



ANGLE REFLECTOR WITH STANDARD HEEL



ANGLE REFLECTOR WITH SNAP RING HOLDER

Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Quantity	Wt., Lbs.	List Price Each
<b>Porcelain Enamel, White Interior, Green Exterior</b>						
W324040	25-40	6 3/4	5 1/4	10	15	\$1 50
W324080	60-75	8 1/4	6 3/4	10	20	1 70
W324200	100-150-200	10 1/2	9	10	20	2 50
W334500	300-400-500	12 1/2	11 1/2	5	25	4 60
W334000	750-1000	15 1/4	15 1/4	5	35	6 80
<b>Enam-Aluminum Interior, Green Baked Paint Exterior</b>						
W224040	25-40-50	6 3/4	5 1/4	10	15	60
W224080	60	8 1/4	6 3/4	10	15	90
W224150	75-100-150-200	10 1/4	9	10	15	1 55

### ANGLE REFLECTORS WITH SNAP RING HOLDERS, FOR BRASS SHELL SOCKETS

The snap-ring holder forms an easy and dependable method of attaching reflectors to brass-shell sockets.

Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Quantity	Wt., Lbs.	List Price Each
<b>Porcelain Enamel, White Interior, Green Exterior</b>						
W314040	25-40	6 3/4	5 3/4	10	15	\$1 65
W314060	40-60	8 1/4	7 1/4	10	15	1 75
W314200	75-100-150-200	10 1/2	9 3/4	10	15	2 75
<b>Enam-Aluminum Interior, Green Baked Paint Exterior</b>						
W214040	25-40	6 3/4	5 3/4	10	15	75
W214080	40-60	8	6 3/4	10	15	1 05
W214200	75-100-150-200	10	9 3/4	10	15	1 80

Order by Style Number

## SHALLOW DOME REFLECTORS



SHALLOW DOME TYPE  
WITH STANDARD HEEL

Shallow dome reflectors are mainly used with small lamps and for outside illumination. The porcelain enamel is of the same quality as used on the R-L-M standard dome type. They are also furnished paint enameled green outside and white inside where low price reflectors are desired.

### SHALLOW DOME REFLECTORS FOR REFLECTOR-SOCKETS

Porcelain Enameled Only

Shallow dome fixtures listed below are combinations of Bayonet-heel reflectors and reflector-sockets. Prices are given for complete fixtures, and for Bayonet-heel reflectors only. In ordering complete fixtures specify style number of reflector-socket (see

"Reflector-Sockets for Bayonet-heel Reflectors") and style number of reflector from following table. For the purpose of determining discounts when ordering complete fixtures, use standard package quantity shown for reflectors only.

For Lamp Size Watts	Lamp Base	Style No.	ONE-PIECE REFLECTORS ONLY		*Price Each	List Price Complete Fixture
			Diameter Inches	STANDARD PACKAGE Quantity Wt., Lbs.		
25-40-60	Medium	W303080	12 1/4	10 20	\$2 00	\$3 30
75	Medium	W303075	12 1/4	10 25	2 20	3 50
100-150-200	Medium	W303150	15 1/4	10 30	2 50	3 80

\*Price of complete fixture includes Bayonet-heel reflector as listed and any reflector socket as listed elsewhere. In ordering give style number of each.

### SHALLOW DOME REFLECTOR WITH STANDARD HEEL—2 1/4-INCH

Standard Heel reflectors may be attached to brass shell sockets by means of the brass holders or to reflector sockets.

	Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Quantity Wt., Lbs.	List Price
Porcelain Enameled.....	W323040	25-40-50	10 1/4	3 3/4	10 15	\$1 25
	W323080	40-60	12 1/4	4 1/4	10 20	1 45
	W323075	75	12 1/4	5	10 25	1 70
	W323150	100-150-200	15 1/4	6 1/4	10 30	2 50
Paint Enameled.....	W223040	25-40-50	10 1/4	3 3/4	10 15	80
	W223080	40-60	12 1/4	4 1/4	10 20	94
	W223075	75	12 1/4	5	10 25	1 02
	W223150	100-150-200	15 1/4	6 1/4	10 30	1 26

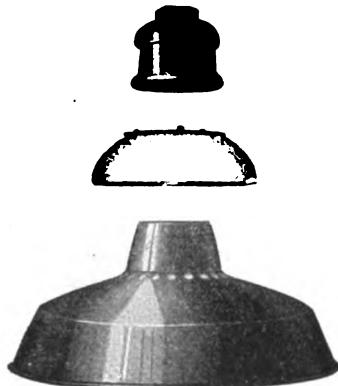
### SHALLOW DOME REFLECTORS WITH SNAP RING HOLDERS, FOR BRASS SHELL SOCKETS

The snap-ring holder forms an easy and dependable method of attaching reflectors to brass shell sockets.

	Style No.	For Lamp Size Watts	Diameter Inches	Depth Inches	STANDARD PKG. Quantity Wt., Lbs.	List Price
Porcelain Enameled.....	W313040	25-40-50	10 1/4	3 3/4	10 15	\$1 40
	W313080	40-60	12 1/4	4 1/4	10 20	1 60
	W313075	75	12 1/4	5	10 25	1 85
	W313150	100-150-200	15 1/4	6 1/4	10 30	2 65
Paint Enameled.....	W213040	25-40-50	10 1/4	3 3/4	10 15	92
	W213080	40-60	12 1/4	4 1/4	10 20	1 06
	W213075	75	12 1/4	5	10 25	1 14
	W213150	100-150-200	15 1/4	6 1/4	10 30	1 38

Order by Style Number

# LUMINOUS-TOP REFLECTOR SOCKET FIXTURES



LUMINOUS-TOP REFLECTOR  
DISASSEMBLED



LUMINOUS-TOP REFLECTOR  
ASSEMBLED

Westinghouse Luminous-Top Reflector-Socket-Fixtures emit a portion of the light upwards, thereby relieving the contrast in lighting intensities above and below the fixture. The upward light also enables workmen to safely make repairs on line shafting, belts and other overhead equipment.

The "Easy to Wire" and interchangeable features of the Reflector-Socket-Fixture line have been retained in the design of this fixture. Luminous-Top reflectors conform to the established standard shape for RLM Dome type reflectors, and are porcelain enameled, green outside and white inside. The vents for emitting light upwards are placed so as not to materially decrease the lighting intensities on the working plane below.

These vents do not weaken the reflector which is still a continuous piece of metal.

The diffusing glass top is of light density but of the right characteristics so that the upward light is evenly distributed over the ceiling. The glass top is held firmly in place by a copper retainer which prevents breakage due to vibration or rough handling. The assembly of this fixture makes it easy to remove and clean the glass top or to replace it if broken.

In designing an installation for uniform lighting these fixtures should be treated as to mounting height and spacing exactly the same as in using regular RLM Dome types.

STYLE NUMBERS		Lamp Size Watts	Reflector Diam. In.	Overall Fixture Height In.	STANDARD Quantity	PACKAGE Weight Lbs.	List Price Complete Fixture
For 1/2-in. Conduit	For 3/4-in. Conduit						
346045	346046	75	12 1/4	5 1/4	10	40	\$4 85
346047	346048	100-150	14 1/4	6 1/4	10	45	5 20
346049	346050	200	16 1/4	7 1/4	5	30	5 85

## PARTS

Style No.		REFLECTOR SOCKET		REFLECTOR		GLASS CAP WITH COPPER CLIP RING	
		Style No.	List Price	Style No.	List Price	Style No.	List Price
346045	Consists of	336387	\$1 30	338921	\$2 50	337994	\$1 05
346047	Consists of	336387	1 30	338923	2 85	337995	1 05
346049	Consists of	336387	1 30	338922	3 50	337995	1 05
346046	Consists of	336388	1 30	338921	2 50	337994	1 05
346048	Consists of	336388	1 30	338923	2 85	337995	1 05
346050	Consists of	336388	1 30	338922	3 50	337995	1 05

Reflectors, Reflector-Sockets, and Glass Caps are each separately packed in pasteboard cartons well protected against damage in transit.

Order by Style Number



## SPECIAL REFLECTORS

### MILL TYPE REFLECTOR



MILL TYPE REFLECTOR

Mill Type reflectors have been developed for use with the new Mill Type B Lamp. This lamp is manufactured with a short P-19 bulb with ring coil

filament and in 25 and 50 watt sizes. For severe service in which standard type B lamps prove unsatisfactory, the new Mill Type lamp equipped with the Mill Type reflector will be found extremely rugged. The Mill Type reflector is porcelain enameled, green outside, white inside. The contour is similar to that of the RLM standard dome; thus assuring efficient distribution of light. Mill Type reflectors may be attached to brass shell or porcelain sockets by means of the brass holders listed elsewhere.

### SEWING MACHINE REFLECTOR

Where a high intensity of illumination is required in a small area or for a special purpose, such as threading the needle of a sewing machine, this reflector will be found very effective. It will accommodate a 10, 15, or 25 watt type B lamp in a S-17 bulb and a 25 or 50 watt Mill Type Lamp in P-19 bulb. Sewing machine reflectors are finished in porcelain enamel, green outside, white inside or green paint enamel outside and aluminum inside. They are furnished with holder to fit brass shell socket.



SEWING MACHINE REFLECTOR

### PORTABLE REFLECTOR WITH EXTENSION



PORTABLE REFLECTOR WITH EXTENSION

This reflector is commonly used in local lighting. It is an improved reflector having a greater depth which shields the lamp to better advantage. This new reflector is made of steel, green paint enamel outside with aluminum finished reflecting surface.

### PRICES

Style No.	Description	Standard Quantity	Package Weight	List Price Each
353017	Mill Type Reflector	10	12	\$1 25
353747	Sewing Machine (Porcelain) Reflector	10	5	95
353778	Sewing Machine (Paint) Reflector	10	5	60
353748	Portable Reflector	10	5	75

Order by Style Number

# VAPOR-PROOF FIXTURES

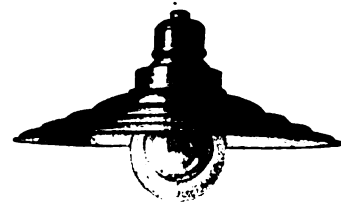
With Easy-to-Wire Reflector Sockets—Approved Construction



VAPOR-PROOF FIXTURE WITH RLM DOME TYPE REFLECTOR AND BALL GLOBE



SECTIONAL VIEW OF VAPOR-PROOF FIXTURE WITH BOWL-TYPE REFLECTOR AND PEAR-SHAPE GLOBE



VAPOR-PROOF FIXTURE WITH CONCENTRIC TYPE REFLECTOR AND PEAR-SHAPE GLOBE



VAPOR-PROOF FIXTURE WITH BALL GLOBE



VAPOR-PROOF FIXTURE WITH PEAR-SHAPE GLOBE AND GUARD

These vapor-proof fixtures are safety-first units of the highest class. They are designed for use in plants where explosive gases and dust accumulating in the standard types of industrial lighting fixtures would cause explosions and fires and where moisture and smoke fumes would hasten corrosion of exposed metal parts.

Each fixture uses the well-known Westinghouse Reflector Socket, approved by the National Board of Underwriters. This socket is easy to wire and is

provided with lamp grips to insure perfect electrical connections and prevent the lamps from loosening when the fixture is subjected to vibration. The cap and globe holder are made of cast iron, heavily galvanized and painted. They will not corrode under the most severe service conditions. Special gaskets are used in all joints to make the fixtures tight. Fixtures may be used with or without lamp guards. Prices below include clear glass globe but not lamp, wiring or guards.

STYLE NUMBERS			Diam. of Reflec. Inches	For Lamp Sizes	Diameter of Globe	Std. Pkg.	Ship. Wt. Lbs., Each	List Price Each
For 1/2-Inch Pipe	For 3/4-Inch Pipe	With 4-Inch Out. Box Cover						
<b>With Globe Only</b>								
345173	345187	345309	....	25-40-60-75	5-in. Ball, Clear	10	15	\$3 25
345174	345188	345310	....	100-150	5-in. Ball, Clear	10	20	3 90
345175	345189	345311	....	200	5x6-in. Pear, Clear	5	25	4 50
345176	345190	345312	....	300-400-500	8-in. Ball, Clear	3	30	6 30
<b>With RLM Dome Reflector</b>								
345177	345191	345313	12	75	5-in. Ball, Clear	10	25	6 25
345178	345192	345314	14	100-150	5-in. Ball, Clear	10	30	7 00
345179	345193	345315	16	200	5x6-in. Pear, Clear	5	35	7 75
345180	345194	345316	18	300-500	8-in. Ball, Clear	3	40	10 35
<b>With Bowl Reflector</b>								
345181	345195	345317	10 1/2	75-100	5-in. Ball, Clear	10	25	6 15
345182	345196	345318	10 1/2	200	5x6-in. Pear, Clear	5	30	7 00
345183	345197	345319	15	300-500	8-in. Ball, Clear	3	35	9 20
<b>With Concentric Reflector</b>								
345184	345198	345320	14	75	5-in. Ball, Clear	10	30	5 50
345185	345199	345321	16	100-150	5-in. Ball, Clear	10	35	6 95
345186	345308	345322	18	200	5x6-in. Pear, Clear	5	40	8 75

†These fixtures will be furnished when so specified (without additional charge) for Crouse-Hinds Condulets, Series LO, CL, BO, BLM, DSO and DESP. Specify type of Condulet when ordering.

Order by Style Number

VAPOR-PROOF FIXTURES—Continued

LAMP GUARDS—HEAVILY TINNED

Style No.	INCHES Diam. Depth	For Fixture Nos.	List Price Each
336420	5 1/2 5	345173, 74, 77, 78, 81, 84, 85, 87, 88, 91, 92, 95, 98, 99, 345309, 10, 13, 14, 17, 20, 21.....	\$1 30
336421	6 1/2 7	345175, 79, 82, 86, 89, 93, 96, 345308, 11, 15, 18, 22.....	1 60
336422	8 1/2 8	345176, 80, 83, 90, 94, 97, 345312, 16, 19.....	2 25

PARTS

These parts are listed for convenience in ordering extra parts and to assist users, dealers, stock-keepers, quotation and price clerks.

Hinds condulets, Series LO, CL, BO, BLM, DSO, or DESP. In ordering specify "with condulet cover" and give the Series designation as used by Crouse-Hinds for the condulets to be fitted.

Any fixture or socket listed on this page can be furnished with cover to fit directly on Crouse-

STYLE NUMBER				STYLE NUMBER			
Fixture	Reflector Socket	Globe	Reflector	Fixture	Reflector Socket	Globe	Reflector
345173	336543	336423	.....	345194	336550	336425	W359500
345174	336544	336423	.....	345195	336545	336423	W347100
345175	336545	336424	.....	345196	336549	336424	W347200
345176	336546	336425	.....	345197	336550	336425	W357500
345177	336543	336423	W349075	345198	336547	336423	W341075
345178	336544	336423	W348150	345199	336545	336423	W341150
345179	336545	336424	W348200	345308	336549	336424	W341200
345180	336546	336425	W359500	345309	336551	336423	.....
345181	336544	336423	W347100	345310	336552	336423	.....
345182	336545	336424	W347200	345311	336553	336424	.....
345183	336546	336425	W357500	345312	336554	336425	.....
345184	336543	336423	W341075	345313	336551	336423	W349075
345185	336544	336423	W341150	345314	336552	336423	W348150
345186	336545	336424	W341200	345315	336553	336424	W349200
345187	336547	336423	.....	345316	336554	336425	W359500
345188	336548	336423	.....	345317	336552	336423	W347100
345189	336549	336424	.....	345318	336553	336424	W347200
345190	336550	336425	.....	345319	336554	336425	W357500
345191	336547	336423	W349075	345320	336551	336423	W341075
345192	336545	336423	W349150	345321	336552	336423	W341150
345193	336549	336424	W349200	345322	336553	336424	W341200

PRICES

Vapor-Proof Reflectors

RLM DOME		DEEP BOWL		CONCENTRIC	
Style No.	List Price Each	Style No.	List Price Each	Style No.	List Price Each
W349075	\$3 00	W347100	\$2 25	W341075	\$1 60
W349150	3 10	W347200	2 50	W341150	2 45
W349200	3 25	W357500	2 90	W341200	2 45
W359500	4 05				

Vapor-Proof Reflector-Socket Parts

Socket Style No.	List Price Each†	Socket Style No.	List Price Each†
336543	\$2 50	336549	\$3 70
336544	3 15	336550	4 60
336545	3 70	336551	2 50
336546	4 60	336552	3 15
336547	2 50	336553	3 70
336548	3 15	336554	4 60

†Price includes globe seat gasket.

Gaskets for Vapor-Proof Fixtures

Description	Style No.	List Price Each
Upper gasket for medium base socket.....	336760	\$0 07
Lower gasket for medium base socket.....	336405	07
Upper gasket for mogul base socket.....	336761	07
Lower gasket for mogul base socket.....	336406	07
Globe seat gasket for 5-inch ball.....	336771	07
Globe seat gasket for 8-inch ball.....	336772	07

Glass Globes

Description	Style No.	List Price Each
5-inch ball vapor-proof globe.....	336423	\$0 75
5x6-inch pear shape vapor-proof globe.....	336424	80
8-inch ball vapor-proof globe.....	336425	1 70

Order by Style Number

## PULLEY-SOCKETS

An almost universal recognition that lighting fixtures must often be cleaned has multiplied the demand for a reliable cut-out and lowering device by means of which cleaning and re-lamping may be



PULLEY SOCKET WITH RLM DOME REFLECTOR

done in absolute safety. Briefly stated the advantages of installing this pulley-socket are:

1. Time saved in cleaning.
2. Elimination of danger in using ladders.
3. Safety from short circuits and accidental contact with live parts.
4. Fixtures may be more thoroughly cleaned with less effort.
5. No obstructions of aisles and reduced distraction of workmen.

A pull on the rope disconnects the electrical parts and the entire fixture comes down dead. This disconnection may be made without first switching off the circuit, for within this pulley-socket wiping contacts are provided of sufficient capacity to make and break the current of a 1000-watt lamp. The next pull resets the fixture in place. An angle reflector may be used. It will always come back to its true position and lock into place so that it is self supporting.

All parts are built in liberal proportions and totally enclosed in a cast iron housing which is galvanized and then painted. The socket is provided with double lamp-grip under which the lamp is held so that it cannot loosen due to vibration.

All pulley-sockets are regularly furnished with a 15-foot rope, which in the course of installing, may be cut off to suit the ceiling height. The rope

coupling is then attached to the end of the rope, this coupling being designed to engage the "S" hook attached to both ends of the trimmer's rope. This arrangement affords a quick means of substantially attaching the trimmer's rope, yet the coupling and "S" hook are small enough to pass over the pulley and through the fixture, making it possible to lower the fixture a distance greater than the length of the rope pendent from the Pulley-socket.

To obtain prices and shipping weights of complete fixtures including reflectors, add to the following the prices and shipping weights for Standard Bayonet-heel reflectors. Pulley-Socket Style No. 338029 will take reflectors of the following style numbers: W306075, W306150, W306200, W307060, W307075, W307150, W307200, W304040, W304060, W304200. Pulley-Socket Style No. 338030 will take reflectors of the following style numbers: W306500, W306000, W307500, W307000, W304500, W304000.



PULLEY SOCKET IN OPERATION

Where Pulley-Sockets are installed on very high ceilings, additional rope may be added by the use of two rope couplings and one "S" hook. Where it is necessary to avoid overhead cranes, etc., the rope from the Pulley-Socket may be brought to the side wall or to a column by the use of Swivel Pole Pulley Style No. 334987 listed on the following page. If additional rope is desired order Style No. 338019, 3/8 inch Weatherproof Lamp Rope as listed in Section 8-A of this catalogue.

In ordering specify style number of pulley-socket, also style number of reflector.

Style No.	Description	STANDARD PACKAGE		List Price
		Quantity	Wt., Lbs.	Each
338029*	Pulley-Socket, medium base, to fit Bayonet-heel reflectors for 200 watt and smaller lamps	10	85	\$7 80
338030*	Pulley-Socket, mogul base, to fit Bayonet-heel reflector for 300 watt and larger lamps....	10	95	8 45

### ACCESSORIES

350583	20-foot Trimmers Rope of 3/8-inch Spot cord with coupling and "S" hook on both ends..	10	10	1 30
350579	Rope coupling with three pins.....	10	1	40
336769	3/4-inch pipe adapter for mounting on brackets.....	10	30	1 00

\*Pulley-Socket only without reflector.  
 One Style No. 350579 Rope Coupling with 3 pins is supplied with each Pulley-Socket.  
 Both Style Nos. 338029 and 338030 are tapped for mounting on 1/2 inch conduit and are supplied with 4 inch outlet box covers for mounting directly on outlet box.

Order by Style Number

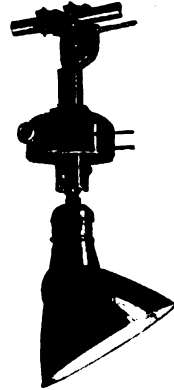
## AUTOMATIC CUT-OUT HANGERS

For Use With Reflector Socket Fixtures on Multiple Circuits

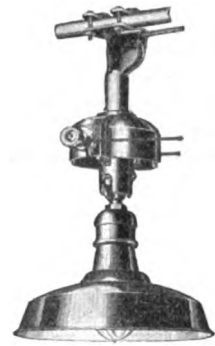
Reliable tests on typical installations show that on an average the loss of light when reflectors are not regularly cleaned, amounts to nearly 50 per cent of that available when systematic cleaning is followed out. These Automatic Hangers facilitate cleaning reflectors without the use of ladders, thus saving much time and expense with absolute protection against accidental short-circuits or contact with live wires. The rope for lowering an automatic cut-out is carried to the nearest column or wall where the attendant hooks on a hand line, then a pull on the rope disconnects the fixture from the circuit. It is then lowered to the floor for cleaning or renewing lamps. The next pull on the rope raises the fixture to its original position, restoring the circuit and automatically locking the fixture in place so that it is supported independent of the rope. This hanger may be used with angle type reflectors and other fixtures designed to throw light in some particular direction, for the lower part of the cut-out as it enters the stationary part always turns to exactly its former position.

The Universal Suspension Clamp furnished with this device may be used for fastening the hanger

to the ceiling on conduit, cable or on a pipe bracket with 3/4 to 1 1/4-inch pipe. The Swivel Pole Pulley and 3/8 or 1/4-inch weatherproof cord or 1/4-inch galvanized ebony wire rope should be used in connection with this cut-out.



AUTOMATIC CUT-OUT HANGER WITH REFLECTOR SOCKET FIXTURE (STANDARD ANGLE TYPE)



AUTOMATIC CUT-OUT HANGER WITH REFLECTOR SOCKET FIXTURE (RLM STANDARD DOME TYPE)

	Std. Pkg.	Shp. Wt. Each	Style No.	List Price Each
With 1/2-inch male thread fitting.....	10	20	345338	\$6 80
With 3/4-inch male thread fitting.....	10	20	345339	6 95

NOTE—Above prices on Automatic Cut-Out Hangers do not include fixtures.

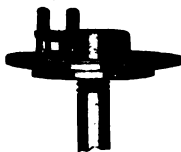


SWIVEL POLE PULLEY

### Swivel Pole Pulleys

This is a weatherproof pole pulley, swiveled so that it can swing sideways and keep in line with the hoisting rope. It has a strong malleable iron pole plate.

Style No.	Std. Pkg.	Wt. Lbs. Each	List Price Each
344987 .....	10	4 1/4	\$1 30



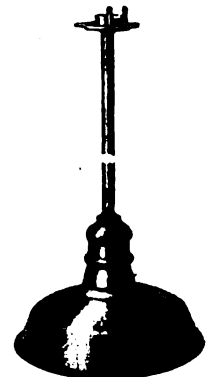
SWIVEL HANGER FOR 4-INCH OUTLET BOX

### ALWAYS-LEVEL SWIVEL HANGER

For Suspension from 4-Inch Outlet Box

This hanger is a ball and socket arrangement which serves as an outlet-box cover supporting the fixture so that it may swing in any direction when struck. Made of cast iron, galvanized and painted green. Tapped for 1/2-inch pipe.

Description	STANDARD QUAN.	PKG. Wt. Lbs.	Style No.	List Price Each
Swivel Hanger.....	10	15	350225	\$0 80



Order by Style Number

## SUSPENSION EYES



SINGLE BUSHED  
SUSPENSION EYE



DOUBLE BUSHED  
SUSPENSION EYE



DOUBLE BUSHED  
EYE WITH INSULATED  
SUSPENSION RING

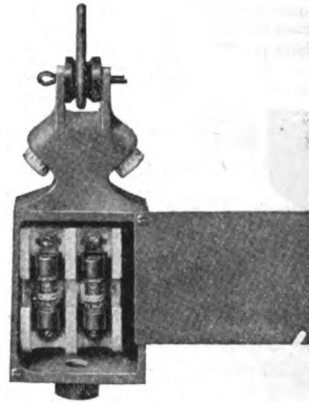
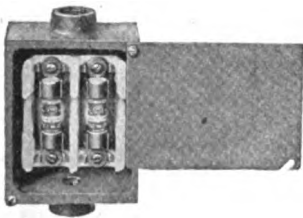
Suspension Eyes are made of cast iron, galvanized and painted. Porcelain bushings protect the entrance wires. For fixtures of low wattage where lamp cord or duplex cord can be used the single bushed suspension eye will be found convenient.

This arrangement allows lighting mains to be run in straight lines on ceilings without interfering with

overhead belting. Double bushed eyes should be used in installations of over 200 watts per fixture. The entire fixture may be insulated when desired by using eyes with porcelain insulated suspension rings. Suspension eyes are threaded for 1/2-inch conduit.

Description	STANDARD PACKAGE		Style No.	List Price Each
	Quantity	Wt. Lbs.		
Single Bushed	10	12	353750	\$0 85
Double Bushed	10	15	335113	95
With Insulated Ring	10	23	344535	1 05

## FUSED SUSPENSION HANGERS



With installations using large lamps of 500 watts or over it is desirable to fuse each fixture. Fused Suspension Hangers are convenient for this purpose and are furnished in two styles as illustrated. The

boxes are of cast iron, galvanized with steel covers. They are threaded to fit 1/2-inch conduit and finished in paint-enameled green.

Description	STANDARD PACKAGE		Style No.	*List Price Each
	Quantity	Wt. Lbs.		
Through Type	10	45	353032	\$4 75
Hanger Type	10	50	352772	6 00

\*Price does not include cartridge fuses.

Order by Style Number

## COMMERCIAL BRACKETS

With Porcelain Enameled Steel Fixtures



STANDARD BRACKET WITH "SOL-LUX" HOLDER AND DIFFUSING BALL GLOBE

These fixtures are especially adapted for outdoor use such as lighting store fronts, shipping platforms, passage ways and storage spaces.

For 200-watt or smaller lamps it is best to use 6x10-inch diffusing ball or acorn globes or 6x8-inch diffusing stalactites; for 300-watt and larger lamps, 8x12-inch diffusing ball or acorn globes are recommended. Fixtures listed below are furnished with double lamp-grip sockets, but are not wired.

Prices below do not include reflectors—for 6x15-inch porcelain-enameled-steel-reflector, Style No. 336086, add \$1.60 list; for 8x18-inch porcelain-enameled-reflector, Style No. 336087, add \$2.60 list.

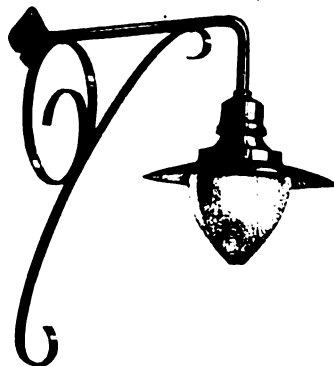
For sign on globe add \$1.95 list for less than 20 letters; add \$3.90 list for 20 to 40 letters.

### STANDARD BRACKETS

A simple form of bracket suspension, consisting of a 3-foot gooseneck of 1/2-inch pipe, with grooved wall-plate for inner wiring.

Description	Ship. Wt. Lbs. Ea.	MED. SCREW SKT. Style No.	List Price Each	MOGUL SCREW SKT. Style No.	List Price Each
With 6-in. holder only.....	10	345377	\$4 40	345378	\$4 65
With 8-in. holder only.....	11	345379	4 65	345380	4 90
With 6x10-in. ball globe.....	17	345381	7 00	345382	7 25
With 6x10-in. acorn globe.....	17	345383	7 95	345384	8 25
With 6x8-in. stalactite.....	16	345385	7 00	345386	7 25
With 8x12-in. ball globe.....	19	345387	8 90	345388	9 15
With 8x12-in. acorn globe.....	19	345389	10 20	345390	10 40

For galvanized bracket, add 40 cents list.



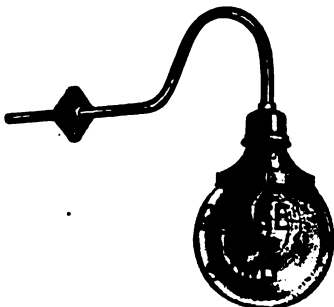
SPARTAN JUNIOR BRACKET WITH "SOL-LUX" HOLDER REFLECTOR AND STALACTITE

### SPARTAN JUNIOR BRACKETS

An artistic and substantial bracket made of 1/2-inch pipe, with wrought iron scroll and grooved wall-plate for inner wiring; holds the lamp 3 feet from wall.

With 6-in. holder only.....	18	345391	6 50	345392	6 75
With 8-in. holder only.....	19	345393	6 75	345394	7 00
With 6x10-in. ball globe.....	25	345395	9 10	345396	9 35
With 6x10-in. acorn globe.....	25	345397	10 10	345398	10 30
With 6x8-in. stalactite.....	24	345399	9 10	345400	9 35
With 8x12-in. ball globe.....	27	345401	10 90	345402	11 20
With 8x12-in. acorn globe.....	27	345403	9 65	345404	12 50

For galvanized bracket, add 90 cents list.



WALL BRACKET WITH "SOL-LUX" HOLDER AND DIFFUSING BALL GLOBE

### WALL BRACKETS

Consists of a 4-foot gooseneck of 1/2-inch pipe with wall-flange; holds the lamp 3 feet from wall, leaving 1 foot of pipe to extend through the wall for interior wiring.

With 6-in. holder only.....	11	345405	4 95	345406	5 20
With 8-in. holder only.....	12	345407	5 20	345408	5 45
With 6x10-in. ball globe.....	18	345409	7 50	345410	7 80
With 6x10-in. acorn globe.....	18	345411	8 50	345412	8 75
With 6x8-in. stalactite.....	17	345413	7 50	345414	7 80
With 8x12-in. ball globe.....	20	345415	9 40	345416	9 65
With 8x12-in. acorn globe.....	20	345417	10 70	345418	10 90

For galvanized bracket, add 50 cents list.



ENTRANCE BRACKET WITH "SOL-LUX" HOLDER, REFLECTOR AND ACORN DIFFUSING GLOBE

### ENTRANCE BRACKETS

Consists of a 4-foot gooseneck of 3/4-inch pipe, elbow and piece of 1/2-inch pipe at outer end; cast iron scroll and wall-plate; holds the lamp 3 feet from wall.

With 6-in. holder only.....	28	345419	8 10	345420	8 35
With 8-in. holder only.....	29	345421	8 35	345422	8 60
With 6x10-in. ball globe.....	35	345423	10 70	345424	10 95
With 6x10-in. acorn globe.....	35	345425	11 65	345426	11 90
With 6x8-in. stalactite.....	34	345427	10 70	345428	10 95
With 8x12-in. ball globe.....	37	345429	12 55	345430	12 80
With 8x12-in. acorn globe.....	37	345431	13 85	345432	14 10

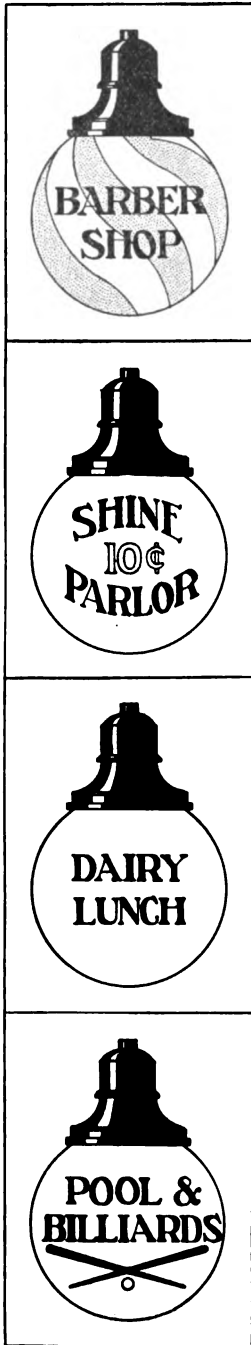
For galvanized bracket, add \$1.30 list.

Order by Style Number

## DISPLAY PENDANTS

"Sol-Lux" display pendants consist of holders with painted diffusing ball globes. Prices include porcelain-enameled-steel holder. Add the price of the display pendants selected to the price of the bracket selected to obtain the list price of the complete fixture.

Signs or emblems are painted on one side only; for painting on two sides, add \$1.75 list; for prices on special lettering and for information regarding brackets, refer to the previous page. Shipping weight of display pendants, 19 pounds; standard package quantity, 10.



### Lunch Room Pendants

Style No.	Description	List Price Each
345433	6-in. holder, 6x10-in. globe, med. sc. skt...	\$8 00
345434	6-in. holder, 6x10-in. globe, mog. sc. skt...	8 30
345435	8-in. holder, 8x12-in. globe, med. sc. skt...	9 90
345436	8-in. holder, 8x12-in. globe, mog. sc. skt...	10 15

### Theatre Pendants

345437	6-in. holder, 6x10-in. globe, med. sc. skt...	8 00
345438	6-in. holder, 6x10-in. globe, mog. sc. skt...	8 30
345439	8-in. holder, 8x12-in. globe, med. sc. skt...	9 90
345440	8-in. holder, 8x12-in. globe, mog. sc. skt...	10 15

### Shine-Parlor Pendants

345441	6-in. holder, 6x12-in. globe, med. sc. skt...	8 00
345442	6-in. holder, 6x10-in. globe, mog. sc. skt...	8 30
345443	8-in. holder, 8x12-in. globe, med. sc. skt...	9 90
345444	8-in. holder, 8x12-in. globe, mog. sc. skt...	10 15

### Billiard Pendants

345445	8-in. holder, 8x12-in. globe, med. sc. skt...	9 90
345446	8-in. holder, 8x12-in. globe, mog. sc. skt...	10 15

### Barber-Shop Pendants

345447	8-in. holder, 8x12-in. globe, med. sc. skt...	11 85
345448	8-in. holder, 8x12-in. globe, mog. sc. skt...	12 10

### Masonic Pendants

345449	8-in. holder, 8x12-in. globe, med. sc. skt...	11 85
345450	8-in. holder, 8x12-in. globe, mog. sc. skt...	12 10

### B. P. O. E. Pendants

345451	8-in. holder, 8x12-in. globe, med. sc. skt...	11 85
345452	8-in. holder, 8x12-in. globe, mog. sc. skt...	12 10

### Knights of Columbus Pendants

345453	8-in. holder, 8x12-in. globe, med. sc. skt...	11 85
345454	8-in. holder, 8x12-in. globe, mog. sc. skt...	12 10

### Standard Brackets

Consist of a 3-foot gooseneck of 1/2-inch pipe, with grooved wall-plate for inner wiring.

Style No.	Description	Shp. Wt., Lbs. Each	List Price Each
345083	Bracket only, painted	4	\$ 90
345084	Bracket only, electro-galvanized and painted	4	1 30

### Wall Brackets

Consist of a 4-foot gooseneck of 1/2-inch pipe and wall plate; holds lamp three feet from wall, leaving one foot of pipe to extend through wall for interior wiring.

345091	Bracket only, painted	5	1 45
345092	Bracket only, electro-galvanized and painted	5	1 95

### Spartan Junior Brackets

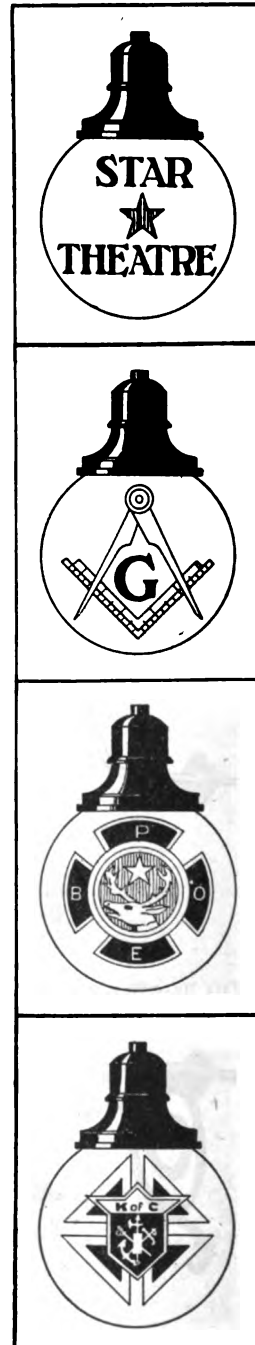
Made of 1/2-inch pipe, with wrought-iron scroll and grooved wall-plate; holds the lamp three feet from wall.

335905	Bracket only, painted	12	3 00
352760	Bracket only, electro-galvanized and painted	12	3 90

### Entrance Brackets

Consist of a 4-foot gooseneck of 3/4-inch pipe, elbow and piece of 1/2-inch pipe, with cast-iron scroll and wall-plate; holds the lamp three feet from wall.

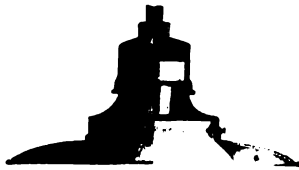
345095	Bracket only, painted	22	4 60
345096	Bracket only, electro-galvanized and painted	22	5 90



Order by Style Number



## PORCELAIN ENAMELED STEEL FIXTURES



WITH ROUND GLOBE



WITH STALACTITE GLOBE

Suitable for store and office lighting. Also for store fronts and similar requirements. These fixtures are made of sheet steel protected with three coats of the best quality porcelain enamel. The holders are ventilated and are tapped at the top for 1/2-inch conduit or other suspension fittings. The same canopy takes either medium or mogul lamp-grip socket and fits to either the 6-inch or 8-inch globe holder.

For 200-watt or smaller Type C lamps, 6x10-inch diffusing ball or acorn globe or 6x8-inch stalactites are recommended; for larger lamps, 8x12-inch ball or acorn globes are preferred

Style No.	Porcelain Enameled Fixtures with Globes Description	Std. Pkg.	Ship. Lbs.	Wt. Ea.	List Price
					Each
344952	6-in. holder, 10-inch diffusing ball, medium screw socket	10	13		\$6 10
344953	Same, with 10-inch diffusing acorn globe	10	13		7 05
344954	Same, with 8-inch diffusing stalactite	10	12		6 10
344955	8-in. holder, 12-inch diffusing ball, medium screw socket	10	17		7 95
344956	Same, with mogul screw socket	10	17		8 25
344957	8-inch holder, 12-inch diffusing acorn, medium screw socket	10	17		9 25
344958	Same, with mogul screw socket	10	17		9 55
336086	Porcelain enameled 6x15-inch reflector, extra	10	7		1 60
336087	Porcelain enameled 8x18-inch reflector, extra	10	8		2 60

When reflectors are wanted always add price shown in last two items and specify reflector style number in addition to fixture style number.

Porcelain Enameled Fixtures without Globes					
Style No.	Description	Std. Pkg.	Ship. Lbs.	Wt. Ea.	List Price Each
336287	6-inch holder, medium screw socket	10	6		3 50
336288	6-inch holder, mogul screw socket	10	6		3 75
336289	8-inch holder, medium screw socket	10	7		3 75
336290	8-inch holder, mogul screw socket	10	7		4 00

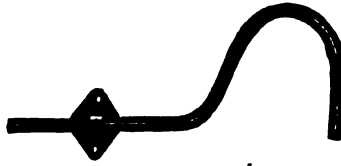
## GOOSENECKS AND FITTINGS



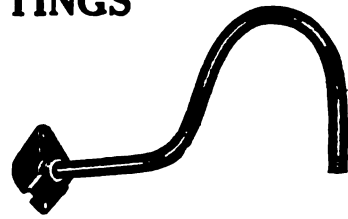
POLE PLATE



CORNER PLATE



1/2-INCH X 4-FOOT GOOSENECK WITH WALL FLANGE



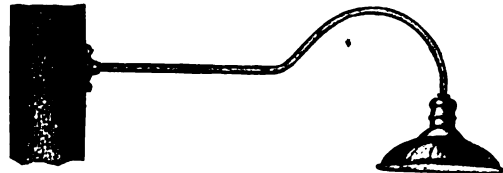
1/2-INCH X 4-FOOT GOOSENECK WITH GROOVED POLE PLATES

Style No.	Description	Std. Pkg.	Weight Lbs., Ea.	List Price Each
334805	3-ft. gooseneck of 1/2-inch pipe, paint enameled	10	2 3/4	\$ 90
334885	4-ft. gooseneck of 1/2-inch pipe, paint enameled	10	3 3/4	1 00
334742	4-ft. gooseneck of 3/4-inch pipe, paint enameled	10	4 3/4	1 15
334861	Grooved pole plate for 1/2-inch pipe, paint enameled	10	1 1/2	35
334741	Grooved pole plate for 3/4-inch pipe, paint enameled	10	2 1/4	60
334791	Wall flange, threaded for 1/2-inch pipe, paint enameled	10	1	40
334884	Same, to slip over 1/2-inch pipe, paint enameled	10	1	40
334894	Wall flange, threaded for 3/4-inch pipe, paint enameled	10	2	55
334890	Same, to slip over 3/4-inch pipe, paint enameled	10	2	55
336047	Corner plate for 1/2-inch pipe, paint enameled	10	2 1/4	1 20
336046	Same, for 3/4-inch pipe, paint enameled	10	2 3/4	1 30

## SPECIAL FARM LIGHTING FIXTURE

For lighting barn yards, driveways, lanes and feed racks; in fact, any outside areas about the farm.

This sturdy, weatherproof fixture consists of a Shallow-Dome Reflector-Socket Fixture, porcelain enameled green outside and white inside, supported by a galvanized gooseneck of 1/2-inch pipe, extending 3 feet to lamp center. A grooved pole plate is regularly furnished for mounting on poles. If fixture is to be mounted on a building, specify "with grooved wall plate."



Style No.	For Lamp Size, Watts	Reflector Diam. Inches	Reflector Depth Inches	Standard Pkg. Quantity	Wt. Lbs.	List Price Each
346103	25-60	12 1/4	3 3/4	10	60	\$4 15
346104	75-150	15 1/4	5 1/4	10	80	4 55

For special requirements as to light distribution any combination may be made of the goosenecks listed above and Reflector-Sockets.

Order by Style Number

## FLOOD-LIGHTING PROJECTORS ENGINEERING DATA

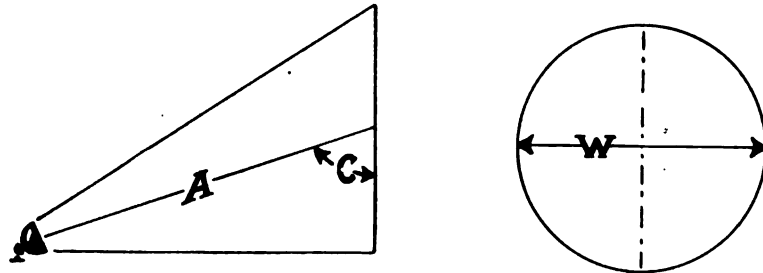


DIAGRAM SHOWING ANGLE OF REFLECTION AND OUTLINE OF ILLUMINATED FIELD

The data given below is approximate for all installations where the angle C of projection lies between 45 and 90 degrees. Although the illuminated field is elliptical in shape when the beam is directed upon it at an angle, the actual variation from a circle is comparatively small between these angles. As the majority of installations will approach such conditions, data covering smaller angles of projection has been omitted. Complicated layouts should be referred to our Illuminating Engineering Bureau for recommendations.

For protective lighting the area surrounding the buildings should be lighted to an intensity of one foot-candle or more. Wide-angle-beam projectors will generally fill the requirements better than narrow-beam.

In the tables below the values of A are assumed distances from the projector to the illuminated field. In column W the diameter of the lighted area is given, and in the column headed "foot-candles" the intensities obtained at the assumed distances from both 500 and 1000-watt lamps are given.

10° SPREAD Narrow-Beam Projector					20° SPREAD Wide-Angle-Beam Projector					30° SPREAD Wide-Angle-Beam Projector				
A in Feet	W in Feet	Area in Sq. Ft.	FOOT CANDLES		W in Feet	Area in Sq. Ft.	FOOT CANDLES		W in Feet	Area in Sq. Ft.	FOOT CANDLES		A in Feet	
			500-Watt Lamp	1000-Watt Lamp			500-Watt Lamp	1000-Watt Lamp			500-Watt Lamp	1000-Watt Lamp		
25	4	13	208	400	9	64	65	200	13	132	25	64.1	25	
50	9	64	52	100	18	254	26	50	27	572	6.2	16.0	50	
75	13	132	23	45	26	530	12	22	40	1,256	2.7	7.2	75	
100	18	254	13	25	35	860	6.5	12.5	54	2,290	1.6	4.0	100	
125	23	415	8.3	16	44	1,520	4.1	8	67	3,500	1.0	2.6	125	
150	26	530	5.8	11	53	2,200	2.9	5.6	80	5,020	.69	1.8	150	
175	31	755	4.3	8	62	3,020	2.1	4.1	94	6,940	.52	1.3	175	
200	35	960	3.2	6.3	71	3,960	1.6	3.1	107	8,990	.39	1.0	200	
225	39	1,193	2.6	5	79	4,980	1.3	2.5	121	11,480	.....	.8	225	
250	44	1,520	2.1	4	88	6,080	1.0	2.0	134	14,090	.....	.65	250	
275	48	1,810	1.7	3.3	97	7,400	.87	1.7	147	16,960	.....	.53	275	
300	52	2,200	1.4	2.8	106	8,820	.73	1.4	161	20,320	.....	.45	300	
325	57	2,550	1.2	2.4	115	10,370	.62	1.2	174	23,750	.....	.38	325	
350	61	3,020	1.1	2.1	123	11,870	.53	1.0	188	27,720	.....	.33	350	
375	66	3,420	.92	1.8	132	13,680	.47	.9	202	31,700	.....	.3	375	
400	70	3,960	.82	1.6	141	15,600	.40	.78	215	36,300	.....	.25	400	
425	75	4,410	.71	1.4	150	17,650	.36	.70	228	40,800	.....	.....	425	
450	79	4,900	.65	1.3	157	19,820	.32	.62	241	45,600	.....	.....	450	
475	83	5,410	.58	1.1	167	21,880	.28	.55	255	51,000	.....	.....	475	
500	88	6,080	.52	1.0	176	24,300	.26	.50	268	56,400	.....	.....	500	

FLOOD-LIGHTING PROJECTORS—Continued



"UNIVERSAL" PROJECTOR WITH STEEL BOW AND TABLE MOUNTING FOR 250 AND 500-WATT FLOOD-LIGHTING LAMPS.



"UNIVERSAL" WITH STEEL BOW AND PIPE STAND



"STANDARD" PROJECTOR WITH STEEL BOW AND TABLE MOUNTING, FOR 300 TO 1000-WATT STANDARD TYPE "C" LAMPS.

"Universal" and "Standard" Flood-Lighting Projectors may be adjusted for any mounting requirement. Narrow and wide-angle-beam reflectors may be used interchangeably in the same body. The reflectors are made of copper, heavily silver-plated and finished with a coat of water and fume-proof lacquer. The narrow-beam reflector has a divergence of 10 degrees and the wide-angle-beam reflector a divergence of 30 degrees.

The mogul-base multiple socket in the "Universal" Projector is adjustable for focusing the lamp. In the "Standard" Projector, the mogul-

base socket is adjustable vertically and horizontally to permit the use of 300, 400, 500, 750 and 1000-watt standard gas-filled lamps.

**Key to Type Letters**—A, cast aluminum body for "Universal;" C, cast iron body for "Universal;" M, cast aluminum body for "Standard;" R, cast iron body for "Standard;" N, narrow-beam reflector; W, wide-angle reflector; S, pipe standard; B, steel bow and table.

**Example**—Type ANB is "Standard" Projector with aluminum body, narrow-beam reflector and steel bow with table.

PRICE LIST AND SPECIFICATIONS

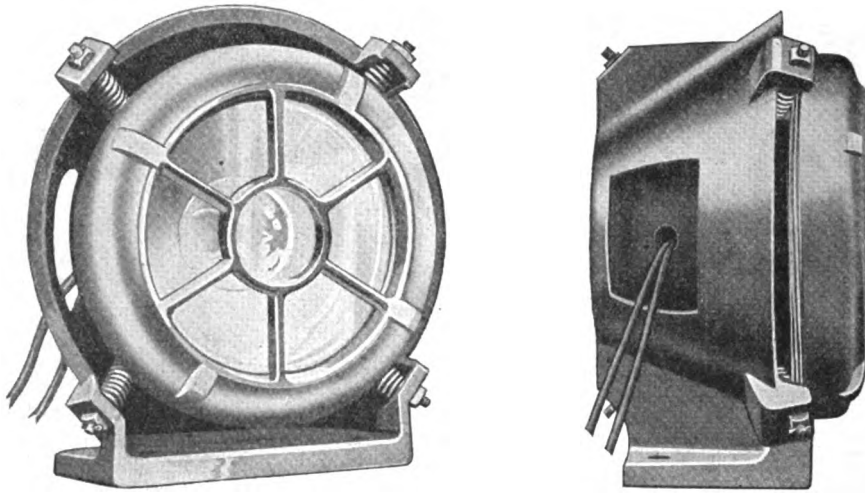
"UNIVERSAL" For 250 and 500- Watt Flood- Light Lamps		"STANDARD" For 300- to 1000-Watt Gas-Filled Lamps		Description	WEIGHT, LBS.		List Price Each
Style No.	Type	Style No.	Type		Net	Ship.	
338180	ANB	335879	MNB	Narrow-beam projector.....	46	81	50 00
350047	ANS	350065	MNS	Narrow-beam projector.....	52	87	52 00
338182	AWB	335880	MWB	Wide-angle-beam projector.....	46	81	50 00
350052	AWS	350066	MWS	Wide-angle-beam projector.....	52	87	52 00
338365	CNB	338369	RNB	Narrow-beam projector.....	70	105	38 00
338367	CNS	338371	RNS	Narrow-beam projector.....	76	111	40 00
338366	CWB	338370	RWB	Wide-angle-beam projector.....	70	105	38 00
338368	CWS	338372	RWS	Wide-angle-beam projector.....	76	111	40 00
348109	AN	348110	MN	Body only, with narrow-beam reflector.....	25	50	45 00
348108	AW	348111	MW	Body only, with wide-angle-beam reflector.....	25	50	45 00
338181	CN	335877	RN	Body only, with narrow-beam reflector.....	49	74	33 00
338183	CW	335878	RW	Body only, with wide-angle-beam reflector.....	49	74	33 00
338174	.....	335881	.....	Narrow-beam reflector only.....	2	5	8 00
338175	.....	335883	.....	Wide-angle-beam reflector only.....	2	5	8 00

ACCESSORIES

338173	Steel bow for any style body.....	6	8	2 00
338172	Table with bolts and nuts for any style body.....	11	15	5 00
345142	Three-foot by 1 1/4-inch pipe stand with table and flange for connecting to bow.....	17	20	7 00
338171	Floor stand only, for 1 1/4-inch pipe.....	11	15	6 00
338170	Bow flange only, for 1 1/4-inch pipe.....	2	4	1 00
339062	16-inch standard wire Glass Fronts.....			4 00

Order by Style Number

## MINE LOCOMOTIVE HEADLIGHTS



STYLE No. 350125 MINE LOCOMOTIVE HEADLIGHT

Westinghouse mine locomotive headlights have been designed to meet a demand for fixtures which are sufficiently rugged to stand up under the hardest possible operating conditions, and yet which carry the lamp on a spring suspension which will adequately protect the filament from breakage due to vibration and jars.

The special features of these headlights which enable them to meet the above requirements, are as follows:

- (1) The frame, case and cover are made of high grade cast iron, heavy enough to withstand a terrific amount of abuse without injury.
- (2) The lens holder is fitted to the case with a threaded joint, which, with rubber gaskets, tightly seals the headlight. A heavy cast-iron grid in front of the lens protects it from breakage.

- (3) The case (which contains the socket and lamp) is entirely suspended from six springs. These springs oppose each other and are always in tension. Thus, the spring suspension is equally effective in all directions, assuring longest possible lamp life.

- (4) A socket is provided for medium base lamps of from 23 to 94-watt capacity. These lamps should be of the concentrated-filament type in the G 18½ and G 25 round bulbs, which are made for use on circuits of from 105 to 130 volts. The headlights may, therefore, be used in multiple on 105 to 130-volt circuits or two in series on 210 to 260-volt circuits.

- (5) The reflector is made of heavy copper, silver plated. Its parabolic shape ensures proper re-direction of the light rays.

### PRICE LIST

Description	Wt. EACH. LBS.		Style No.	List Price Each
	Net	Shipping		
Mine Locomotive Headlight, type gas proof, electrical connection assembled on left-hand side facing headlight.....	84	110	350125	\$36 00
Mine Locomotive Headlight, type gas proof, electrical connection assembled on right-hand side facing headlight.....	84	110	336513	36 00

### Repair Parts

Description	Net Wt., Each in Pounds	Style No.	List Price Each
Mine Locomotive Headlight Without Frame.....	13	339128	6 25
Mine Locomotive Headlight Cover.....	8½	339129	7 25
Mine Locomotive Headlight Lens (glass front).....	1¼	339134	2 50
Mine Locomotive Headlight Suspension Spring with bolt and nuts.....	.....	335277	90
Rubber Gasket between lens and cover.....	.....	339131	10
Rubber Gasket between cover and case.....	.....	339132	10

Prices are f.o.b. factory, South Bend, Indiana.

Order by Style Number

MINE LOCOMOTIVE HEADLIGHTS—Continued

HEADLIGHT RESISTORS

Where headlights are to be operated on circuits of more than 260 volts a resistance is required. The resistor listed below is designed to take care of 36-watt 125-volt lamps on circuits of 260 to 825 volts, according to the method of connection as listed below.

The resistance is housed in a full cast-iron case and cover with open grid sides and top as shown on the dimension drawing. This housing is very sturdy, being far superior in this respect to the sheet steel housings usually furnished.

Within the case are mounted two 50-watt, 600-ohm resistor tubes. The resistor, therefore, is capable of dissipating 100 watts and has a total resistance of 1200 ohms.

The following are the various combinations of 36-watt 125-volt lamps with resistors:

One headlight on 130 to 475-volt circuit, one resistance box required.

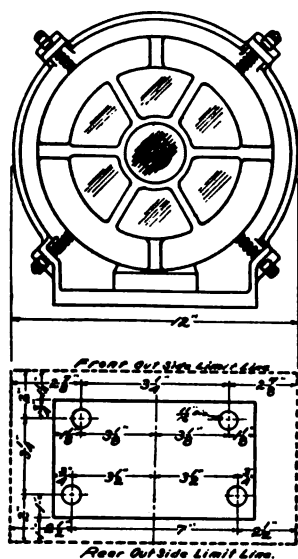
One headlight on 475 to 825-volt circuit, two resistance boxes required.

Two headlights in series on 260 to 600-volt circuit, one resistance box required.

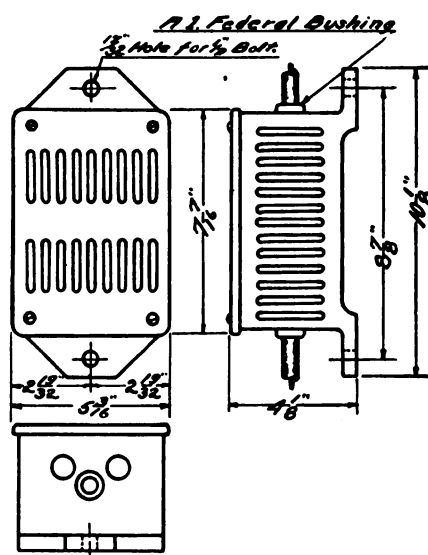
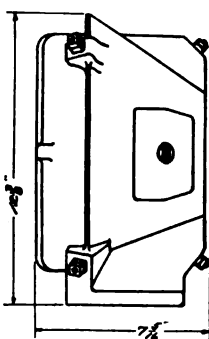
In case it is desired to use other than the 36-watt lamps, special resistors can be furnished. Prices will be quoted upon request.

Prices are f.o.b. Factory, South Bend, Indiana.

Description	WT. EACH., LBS.		Style No.	List Price Each
	Net	Shipping		
Resistance Unit for Mine Locomotive Headlight.....	13	18	336531	\$17 50



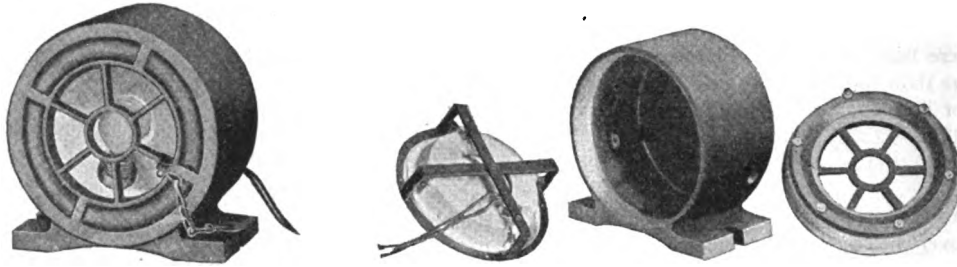
DIMENSIONS OF STYLE NO. 350125 HEADLIGHT



DIMENSIONS OF RESISTOR STYLE NO. 336531

Order by Style Number

MINE LOCOMOTIVE HEADLIGHTS—Continued



This new Westinghouse Type S is a "permissible" headlight for gaseous mines. It is sufficiently rugged to withstand the hardest possible operating conditions, and so compact as to fit in the available space at the ends of mine locomotives with ample clearance to safeguard against breakage. The lamp, its receptacle and the reflector are mounted in a spring-suspended frame which protects the lamp filament from breakage due to vibration and jars.

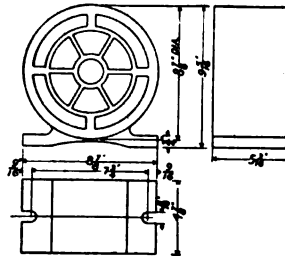
The housing and front cover are made of high grade cast iron, heavy enough to withstand a terrific amount of abuse without injury.

The front cover is fitted to the case by machined threads with cork gaskets, each side of glass front allowing an inch of actual creepage distance in all joints, so that any gases ignited within the headlight will be cooled before reaching the outside. The cover of this headlight has a threaded fit of fully an inch and a machined flange in addition. The glass front is 1/2 inch thick to conform with requirements.

The reflector-socket and lamp are assembled in

a framework which is suspended on springs within the cast iron housing.

A socket is provided for medium base lamps of from 23 to 94 watt capacity. The lamps used should be of the concentrated filament type in the G 18 1/2 and G 25 round bulbs, which are made for use on circuits of from 105 to 130 volts. The headlights may, therefore, be used in multiple on 105 to 130 volt circuits, or two in series on 210 to 260 volt circuits. For special voltages use headlight resistors, Style No. 336531.



Style No.	Description	WEIGHT EACH, LBS. Net	Shipping	List Price Each
350219	Type S Mine Locomotive Headlight, approved gas-proof construction.	39	45	\$30 00

Repair Parts

350255	Glass retaining ring	1 1/2		\$ 90
352821	Reflector support assembly	2		6 25
352823	Socket			50
350257	Suspension spring			15
350254	Cast iron cover	9		4 25
352815	Cover holding chain			55
350264	Socket retaining stud			35
350260	Reflector	1		4 00
350262	Glass front	2		2 00
353789	Outside cork gasket	..		10
353790	Inside cork gasket	..		10

Order by Style Number

## SAFETY MOTOR STARTERS TYPES WK-10 AND WK-20

For Starting Small Single-Phase, Two-Phase and  
Three-Phase Motors—125, 250, 440 and 550 Volts A-C.



TYPE WK-10  
(Door Open)



TYPE WK-20  
Arranged for Plug-Type  
Thermal Cutouts



TYPE WK-20 2-POLE  
Arranged for Cartridge-Type  
Thermal Cutout

All type WK-10 and WK-20 motor starters are equipped with provision for locking the switch in the "OFF" position to protect those working on the machines controlled by the starter.

A door, which is so interlocked with the switch mechanism that it may be opened only when the switch is in the "OFF" position and all reachable parts are dead, covers those parts requiring inspection and occasional renewal.

If desired, this door may also be padlocked.

### Distinctive Features

**Protection to the Motor**—The motor is protected from overloads both when starting and while running, by means of thermal cutouts. The time lag of these thermal cutouts allows reasonably high starting currents or momentary overloads which would do no damage to the motors. When subjected, however, to a continuous overload sufficient to overheat or damage the motor, such as; polyphase motors running single-phase, motors carrying dangerous overloads continuously, or motors that show a tendency to stall where efforts are made to start them; then the thermal cutouts serve to quickly open the circuit thus assuring absolute protection to the motor.

The switches are quick-made and quick-break, thus allowing them to easily break the locked current of the largest motor having a normal current within the limit of the rating of the switches.

### Construction

**Simplicity**—All type WK-10 and WK-20 motor starters are single-throw. The motor is started by turning the switch to the "ON" position and is stopped by turning it to the "OFF" position.

Switches equipped with standard fuses only must be of the double-throw type for starting squirrel-cage and other motors of large starting current, in order to comply with the Underwriter's rules, since the fuses that furnish overload protection for

running must be cut out of the circuit during starting. This complication is avoided in the WK-10 and WK-20 motor starters through the use of time-limit thermal cutouts.

**Ease of Installation and Repair**—The entire switching mechanism can be inspected by removing the screws that hold the cover on.

Switch can be removed and renewed from the front without disturbing the box or conduits.

Knockouts are provided in the sides and ends of the box.

Line terminals and motor terminals are plainly indicated.

The capacity of each starter can be changed within its range by substituting the proper thermal cutouts.

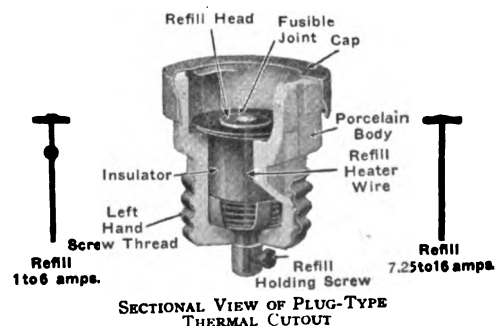
All these starters are small, light weight, and compact.

**Other Advantages**—The box is made dust-proof by the overlapping cover.

All Westinghouse WK-10 and WK-20 motor starters are arranged to disconnect all wires of the circuit thus saving a separate disconnecting switch which is required in the case of auto starters.

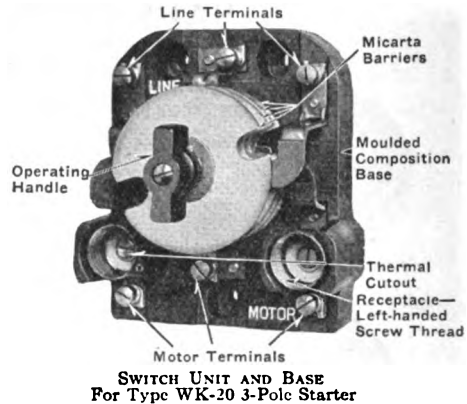
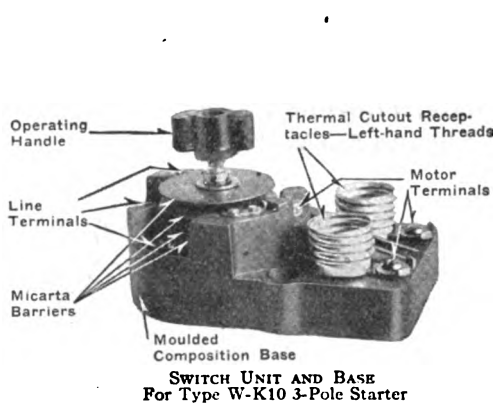
Each starter is packed in a neat corrugated paper carton with ratings indicated on the label.

These switches have the approval of National Board of Fire Underwriters.



12-151A

TYPES WK-10 AND WK-20 MOTOR STARTERS—Continued



LIST PRICES

TYPES WK-10 AND WK-20 MOTOR STARTERS, PLUG-TYPE THERMAL CUTOUTS AND REFILLS FOR PLUG-TYPE THERMAL CUTOUTS

List prices of WK-10 and WK-20 motor starters include starter complete with necessary plug-type thermal cutouts. For extra cutouts refer to plug cutout table.

Style number of starter does not include plug cutouts therefore when ordering specify style number of starter and style numbers of plug cutouts required.

Omission prices—If plug cutouts are not desired an omission price of \$1.25 list, each, should be deducted from list price of starter.

Note—2 pole requires 1 plug cutout; 3 pole requires 2 plug cutouts; 4 pole requires 2 plug cutouts.

TYPES WK-10 and WK-20 Motor Starters

Style No.	Type	Poles	MAXIMUM HP.				Cutouts Required	Ship. Wght. Lbs.	List Price Each Starter Complete with Cutouts
			125 Volt	250 Volt	440 Volt	550 Volt			
K-55863	WK-10	2	1	2			1-Plug	6	\$10 00
K-55864	WK-10	3	2	2	2		2-Plug	6	12 00
K-55865	WK-20	2	1	3			1-Plug	8	10 50
K-57530	WK-20	2	3	5	5		1-Cartridge	8	11 50
K-55866	WK-20	3	2	5	5		2-Plug	8	13 00
K-57259	WK-20	4	2	5	5		2-Plug	8	16 50

Plug-Type Thermal Cut-outs

Style No.	Amps.	Max. A.-C. Volts*	List Price Each	Style No.	Amps.	Max. A.-C. Volts*	List Price Each
306343	1.0	550	\$1 25	306340	6.00	550	\$1 25
306344	1.5	550	1 25	306339	7.25	440	1 25
306345	2.0	550	1 25	306338	8.00	440	1 25
306346	2.5	550	1 25	306337	9.25	440	1 25
306347	3.0	550	1 25	306336	10.50	250	1 25
306348	3.5	550	1 25	306335	11.75	250	1 25
306349	4.0	550	1 25	306334	13.00	250	1 25
306342	4.5	550	1 25	306333	14.25	250	1 25
306341	5.0	550	1 25	306332	16.00	250	1 25

Two extra refills are furnished with each cutout.  
 \*Since these cutouts interrupt the circuit, they must be applied within their maximum voltage rating.  
 All plugs are standard size; any refill will fit all plugs.

Refills for Plug-Type Thermal Cutouts

NOTE—Each refill is operable only at its rated current capacity.

Style No.	Amperes	List Price Each	Style No.	Amperes	List Price Each	Style No.	Amperes	List Price Each
306325	1.0	\$0 05	306331	4.0	\$0 05	306319	9.25	\$0 05
306326	1.5	05	306324	4.5	05	306318	10.50	05
306327	2.0	05	306323	5.0	05	306317	11.75	05
306328	2.5	05	306322	6.00	05	306316	13.00	05
306329	3.0	05	306321	7.25	05	306315	14.25	05
306330	3.5	05	306320	8.00	05	306314	16.00	05

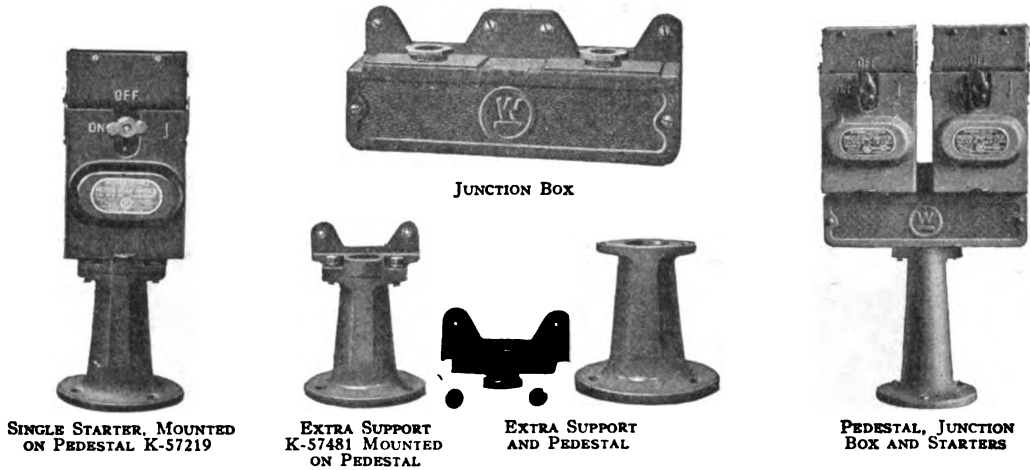
†For Cartridge-Type Thermal Cutouts see page 995

Order by Style Number



TYPES WK-10 AND WK-20 MOTOR STARTERS—Continued

Accessories for Use With WK-10 and WK-20 Motor Starters in Textile Mills



In connection with the applications of WK-10 motor starters in the textile field, it is sometimes necessary to have the switches mounted in pairs on pedestals very near the floor. For this purpose junction boxes and pedestals, as shown in the accompanying photographs, have been developed. The switches are held firmly to the junction box by mounting screws and combination locknuts and bushings which are clamped through the knockout hole in the bottom of the switch into the junction

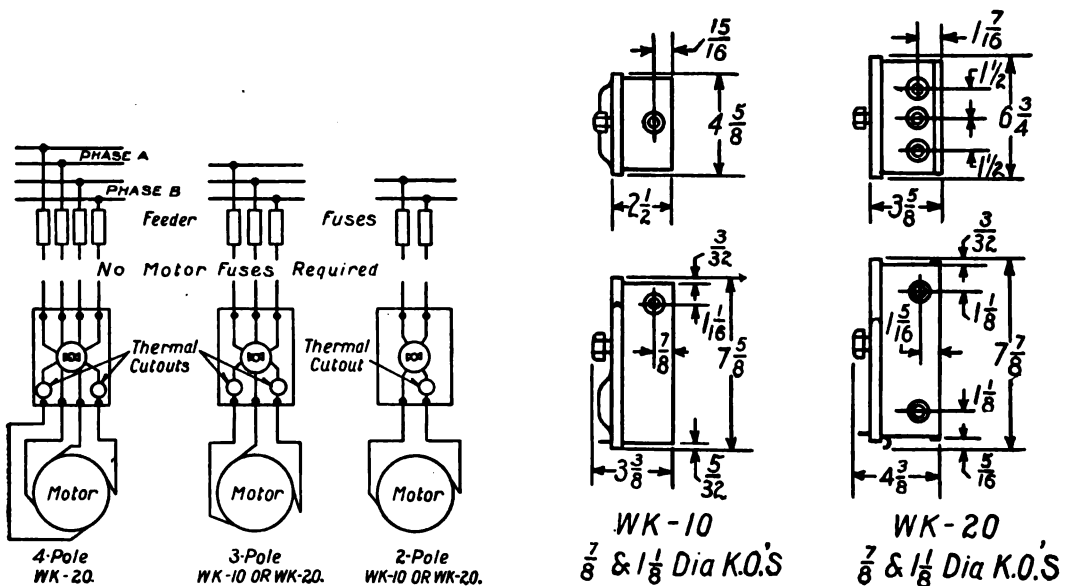
box. It in turn is fastened to the pedestal by means of machine bolts and lock washers.

The pedestals are made in two sizes, 4 $\frac{3}{4}$  and 6 $\frac{3}{4}$  inches high, making the overall height of the outfit 15 $\frac{1}{8}$  inches when the smaller pedestal is used and 17 $\frac{1}{8}$  inches when the larger pedestal is used.

The whole outfit presents a very neat appearance and has been designed with a minimum number of projections to reduce the catching of lint or other foreign substances.

		Approx. Ship. Wt.	List Price Each
K-57216	Junction box and cover complete, for mounting two WK-10 starters	6 lbs.	\$2 75
K-59396	Junction box and cover complete, for mounting two WK-20 starters	8 lbs.	3 50
K-57218	Pedestal, 4 $\frac{3}{4}$ -inches high	2 $\frac{3}{8}$ lbs.	1 40
K-57219	Pedestal, 6 $\frac{3}{4}$ -inches high	3 $\frac{3}{8}$ lbs.	1 40
K-57481	Extra support (necessary), for mounting one (1) WK-10 starter on above pedestals	2 lbs.	1 40
K-59511	Extra support (necessary), for mounting one (1) WK-20 starter on above pedestals	2 lbs.	1 50

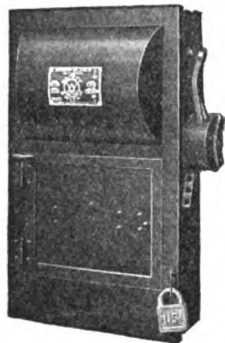
Types WK-10 and WK-20 Dimensions, Connections and Knockouts



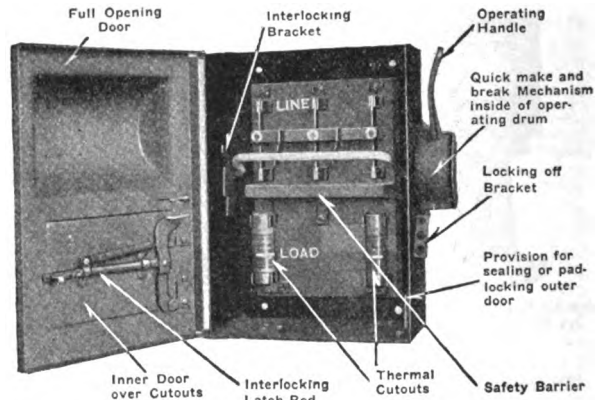
Order by Style Number

## SAFETY MOTOR STARTERS TYPE WK-30

For A-C. Motors up to 3 Hp., 110 Volts; 10 Hp., 250 Volts;  
10 Hp., 600 Volts



TYPE WK-30 MOTOR STARTER  
(OUTER DOOR LOCKED SHUT)



TYPE WK-30 MOTOR STARTER  
(OUTER DOOR OPEN)

### Application

Westinghouse type WK-30 motor starters are adaptable for heavy motor application, especially where the starting conditions require a time element approximately equal to the motor, such as woodworking machines, grinding and emery wheels, machine shops, pumps, compressors and similar applications.

The type WK-30 motor starter, equipped with Westinghouse cartridge type thermal cutouts resembling, but not interchangeable with N. E. C. fuses, is ideal for throwing small alternating-current motors directly on the line. The design of this switch is the same as that of the WK-55 quick-make and-break switch, except the base, is equipped for thermal cutouts instead of N. E. C. fuses. The full-safety features of this switch provide 100 per cent protection to the workman in renewing or replacing cutouts since this is accomplished through the interlocked door over the cutout compartment.

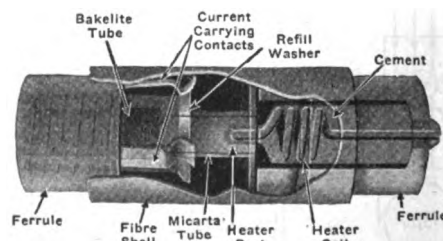
### Distinctive Features

The thermal cutouts protect the motor against injurious overloads by opening the circuit just before the danger point is reached. The ingenious construction and arrangement of arcing barriers in these cutouts permit them to break many times their rated current capacity. Momentary high starting currents or brief overloads, necessary and frequent in motor operation, do not injure the motor and, therefore, do not affect the cutouts which have the correct time limit lag to operate only when the motor is in danger. The operation of the cutout

destroys a fusible washer which may be replaced in a few seconds time at a negligible cost. These washers are the same for all cartridge type cutouts regardless of capacity.

### Instructions for Ordering

In ordering thermal cutouts to be used with WK-30 motor starters be sure to indicate the terminal ampere rating of the motor as shown on the motor name-plate. Unless otherwise specified, cutouts will be furnished of the same capacity as the ampere rating of the motor at the terminals. This will allow 10 per cent overload capacity to the motor. If it is desired to operate the motor under heavier overload, larger cutouts should be ordered. For example, suppose it is required to operate the motor continuously at 25 per cent overload. A thermal cutout of a capacity 25 per cent greater than the terminal amperes of the motor would be required. The cutouts having a 10 per cent overload rating will then operate to open the circuit, should the current of the motor reach  $137\frac{1}{2}$  per cent.



PHANTOM OF CARTRIDGE-TYPE CUTOUT

TYPE WK-30 MOTOR STARTERS—Continued

LIST PRICES

List prices of type WK-30 Motor Starters include starter complete with necessary cartridge type cutouts. For extra cutouts refer to cartridge cut-out table.

Omission prices—If cartridge type cutouts are not desired, an omission price of \$1.50 list each should be deducted from list price of starter.

Style numbers of starters do not include cutouts, therefore when ordering specify style number of starter and style numbers of cutouts required.

Note—2-pole starters require 1 cutout; 3-pole starters require 2 cutouts; 4-pole starters require 2 cutouts.

Motor Starters

250 Volts					600 Volts						
Style No.	Amperes*	Phase	Poles	No. of Thermal Cutouts Required	List Price Each	Style No.	Amperes*	Phase	Poles	No. of Thermal Cutouts Required	List Price Each
K-55000	30	1	2	1	\$20 50	K-55004	10	3	3	2	\$30 00
K-55001	30	3	3	2	23 00	K-55005	10	2	4	2	33 00
K-55002	30	2	4	2	27 00						

\*Current shown is rating of switch. As a motor starter the hp. capacity is dependent upon the ampere rating of the thermal cutouts with which the starter is equipped.

Thermal Cutouts for Above Motor Starters  
Cartridge Type

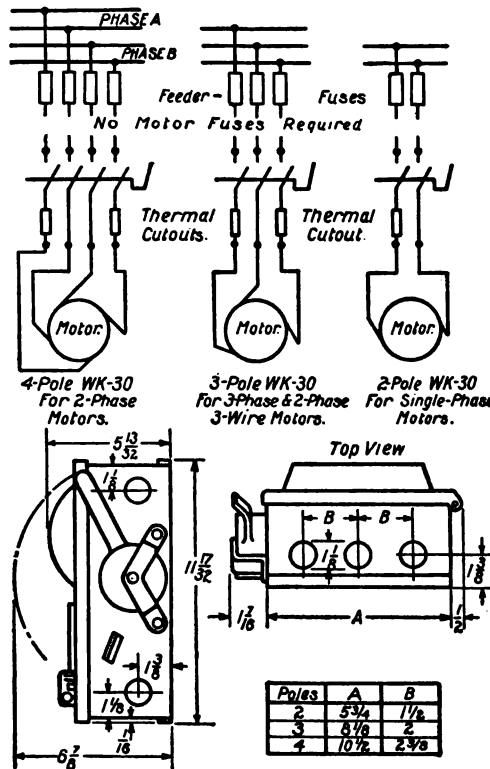
Style No.	Amperes	Maximum Voltage†	List Price Each	Style No.	Amperes	Maximum Voltage†	List Price Each
296672	1	600	\$1 50	296682	7	600	\$1 50
296673	1½	600	1 50	296683	8	600	1 50
296674	2	600	1 50	296684	9	600	1 50
296675	2½	600	1 50	296685	10	600	1 50
296676	3	600	1 50	296686	12	500	1 50
296677	3½	600	1 50	296687	15	250	1 50
296678	4	600	1 50	296688	20	250	1 50
296679	4½	600	1 50	296689	25	250	1 50
296680	5	600	1 50	302106	30	250	1 50
296681	6	600	1 50	302107	35	250	1 50

With each thermal cutout are furnished two extra refill washers.  
†While the operation of these cutouts is independent of the voltage, their arc rupturing capacity is limited by the voltages indicated above.

Extra Refill Washers for Above Thermal Cutouts

315656—Refill washers..... \$0 05

Type WK-30 Dimensions, Connections and Knockouts

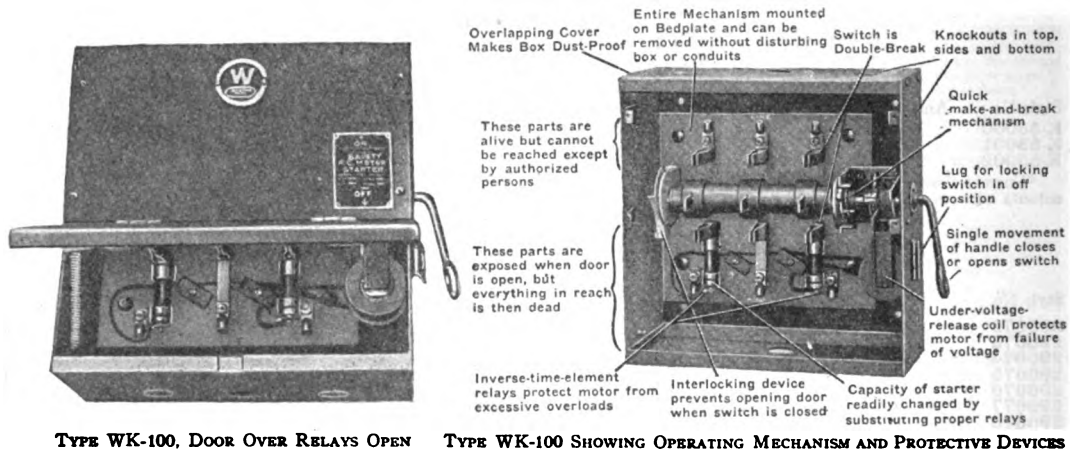


Order by Style Number

## SAFETY MOTOR STARTERS TYPE WK-100

WITH AUTOMATIC OVERLOAD AND UNDERVOLTAGE TRIP FOR A-C.  
MOTORS UP TO 3 Hp., 110 VOLTS—10 Hp., 250 VOLTS—15 Hp., 550 VOLTS

### Single-Throw—Quick-Make and Quick-Break



TYPE WK-100, DOOR OVER RELAYS OPEN

TYPE WK-100 SHOWING OPERATING MECHANISM AND PROTECTIVE DEVICES

The type WK-100 safety motor starters afford absolute protection to the operator (regardless of experience) as well as to the motor, and at the same time, cost so little as to warrant their installation with every induction motor of one to fifteen hp. capacity, single or polyphase. These starters connect the motor directly to the line without the use of resistance or auto-transformers.

### Operation

The operation of the type WK-100 starter is the simplest possible—there are no complicated directions to remember. The switch is closed and opened by moving the operating handle to the "ON" and "OFF" positions.

### Construction

The switch mechanism is enclosed in a steel box, which is arranged for wall mounting. The cover consists of two parts, connected together by hinges, the upper part being held in place by screws, while the lower part forms a door which gives access to the protective devices. This door is so arranged that it can be opened only when the switch is in the "OFF" position, and when the door is open the switch cannot be thrown "ON." Hence all parts accessible when the door is open are electrically dead.

A complete unit is formed by mounting the switch mechanism on a slate base and this unit may be removed or replaced without disturbing the box or

the conduits. A damaged switch can, therefore, be readily renewed.

The movable knife blades are moulded into Bakelite hubs, which are mounted on a square steel shaft and separated by Bakelite Micarta spacers. On 550 and 600-volt starters, parts of opposite polarity are separated by barriers, rigidly mounted on the slate base.

The operating handle rotates the blade shaft through a spring actuated mechanism, which provides a quick-make and quick-break, regardless of the speed with which the handle is operated. The switch blades are double break, affording the maximum breaking capacity for the switch.

The undervoltage release consists of a magnetically-operated catch, which holds the switch in the closed position only when the line voltage is sufficiently high. Should the voltage fail, the switch opens automatically. The undervoltage coil is connected across the load side of the switch and, therefore, consumes power only when the motor is operating.

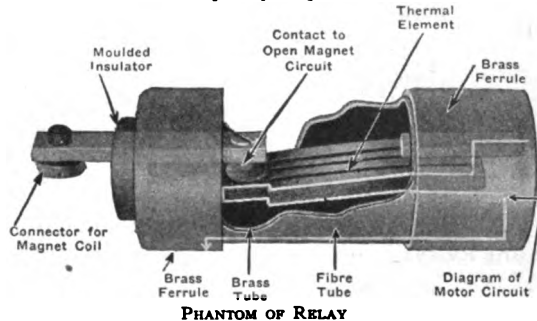
### Thermal Relays

The inverse-time-element overload release consists of one or more thermal relays (the number depending on the number of the phases) which resemble cartridge fuses in appearance. Momentary overloads do not affect these relays, but should the load become so heavy as to endanger the motor,

TYPE WK-100 MOTOR STARTERS—Continued

the relays operate to open the switch. Standard thermal relays are rated similar to N. E. C. fuses, up to and including 35 amperes, and should be ordered for rated capacity required.

coil is suitable for use on its rated voltage and frequency only). Hence, to change the capacity of the switch, all that is necessary is to change the thermal relays to the required size.



In ordering thermal relays to be used with WK-100 motor starters be sure to indicate the terminal ampere rating of the motor. Unless otherwise specified, we will furnish relays of the same capacity as the ampere rating of the motor at the terminals. This rating will allow an overload capacity to the motor of 10 per cent. If it is desired to operate the motor under a heavier overload, larger relays should be ordered. For example, suppose it is required to operate the motor continuously at 25 per cent overload, then thermal relays of a capacity 25 per cent greater than the terminal amperes of the motor would be required. The relays which have a 10 per cent overload rating will then operate to open the circuit should the current of the motor reach 137½ per cent.

The capacity of the switch depends solely on the thermal relays, as all other parts of the mechanism are the same for all capacities (although the magnet

LIST PRICES

List prices of type WK-100 Motor Starters include starter complete with necessary relays. For extra relays refer to relay table.

Style numbers of starters do not include relays, therefore when ordering specify style number of starter and style numbers of relays required.

Omission Prices—If relays are not desired, an omission price of \$1.75 list each should be deducted from list price of starter.

Note—2-pole starters require 1 relay; 3-pole starters require 2 relays; 4-pole starters require 2 relays.

Style No.	Maximum Amperes*	Phase Voltage	Coil Voltage	Cycles	No. and Kind of Relays Required	List Price Each
<b>Single-Phase—2-Wire</b>						
K-55570	30	110	110	25	} 1 Circuit-Opening	\$26 00
K-55580	30	110	110	60		24 50
K-55573	30	220	220	25		26 00
K-55622	30	220	220	60		24 50
<b>Three-Phase—3-Wire</b>						
K-55571	30	110	110	25	} 2-Circuit-Opening	29 00
K-55581	30	110	110	60		27 00
K-55574	30	220	220	25		29 00
K-55623	30	220	220	60		27 00
K-55576	30	440	440	25		30 50
K-55583	30	440	440	60		29 00
K-55578	30	550	550	25		35 00
K-55585	30	550	550	60		33 00
<b>Two-Phase—3-Wire</b>						
K-57225	30	110	156	25	} 2 Circuit-Opening	30 50
K-57227	30	110	156	60		28 50
K-57229	30	220	312	25		30 50
K-57231	30	220	312	60		28 50
K-57233	30	440	624	25		32 00
K-57234	30	440	624	60		30 50
K-57236	30	550	776	60		34 50
<b>Two-Phase—4-Wire†</b>						
K-57226	30	110	110	25	} 1 Circuit-Opening	32 00
K-57228	30	110	110	60		30 50
K-57230	30	220	220	25	} 1 Circuit-Closing	32 00
K-57232	30	220	220	60		30 50
K-57235	30	440	440	60		32 00
K-57237	30	550	550	60		37 50

\*Current shown is rating of switch; as a motor starter the horse power capacity is dependent on the ampere rating of the thermal relays with which the starter is equipped.

†Phases either independent or connected.

When ordering, specify style number of switch and order thermal relays extra by style number from table. For 40 and 50 cycles, specify the same style number as 60 cycles, except to be arranged for 40 or 50 cycles, as the case may be.

It will be noted from the above table that each 4-pole starter requires one circuit-opening and one circuit-closing relay. All other starters require only circuit-opening relays. Consult relay tables for proper style number to order.

Order by Style Number

TYPE WK-100 MOTOR STARTERS—Continued

THERMAL RELAYS FOR WK-100 MOTOR STARTERS

Circuit-Opening Relays

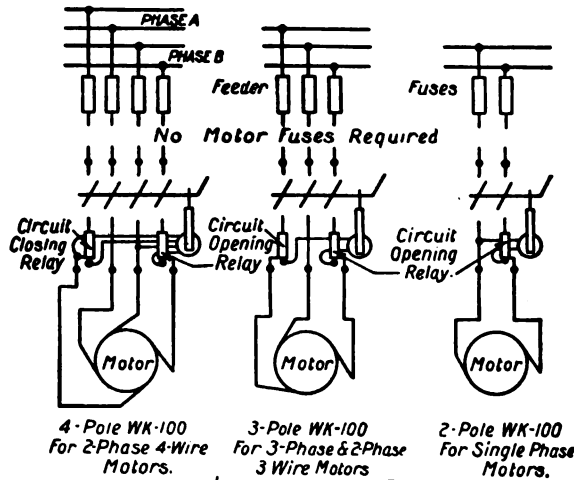
Style No.	Amperes	List Price Each	Style No.	Amperes	List Price Each
311784	1	\$1 75	311791	7	\$1 75
308250	1½	1 75	311792	8	1 75
311785	2	1 75	308253	9	1 75
311786	2½	1 75	311793	10	1 75
308251	3	1 75	311794	12	1 75
311787	3½	1 75	308254	15	1 75
311788	4	1 75	311795	20	1 75
308252	4½	1 75	311796	25	1 75
311789	5	1 75	308255	30	1 75
311790	6	1 75	311797	35	1 75

Circuit-Closing Relays

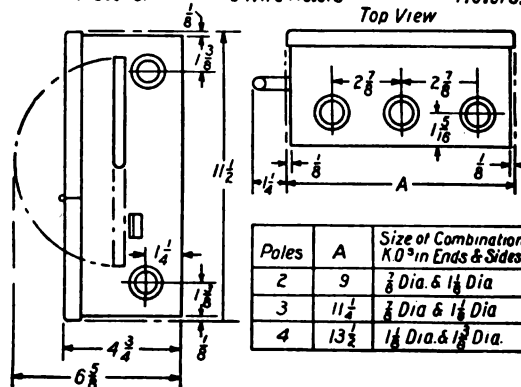
Style No.	Amperes	List Price Each	Style No.	Amperes	List Price Each
318098	1	1 75	318105	7	1 75
318092	1½	1 75	318106	8	1 75
318099	2	1 75	318095	9	1 75
318100	2½	1 75	318107	10	1 75
318093	3	1 75	318108	12	1 75
318101	3½	1 75	318096	15	1 75
318102	4	1 75	318109	20	1 75
318094	4½	1 75	318110	25	1 75
318103	5	1 75	318097	30	1 75
318104	6	1 75	318111	35	1 75

Important—In ordering thermal relays for WK-100 motor starters, the ampere-per terminal rating as shown on the motor name plate must be given. Relays should be ordered by style number from the above tables. While the operation of these relays is independent of the voltage, they should not be used on circuits above 600 volts.

Type WK-100 Dimensions, Connections and Knockouts



4-Pole WK-100 For 2-Phase 4-Wire Motors.  
 3-Pole WK-100 For 3-Phase & 2-Phase 3 Wire Motors.  
 2-Pole WK-100 For Single Phase Motors.



Poles	A	Size of Combination KO in Ends & Sides
2	9	7/8 Dia. & 1 1/8 Dia.
3	11 1/4	7/8 Dia. & 1 1/8 Dia.
4	13 1/2	1 1/8 Dia. & 1 3/8 Dia.

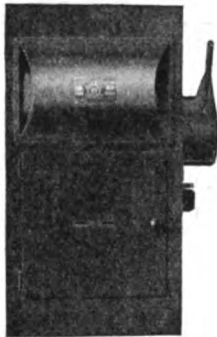
Order by Style Number

## INDUSTRIAL SAFETY SWITCH—TYPE WK-55

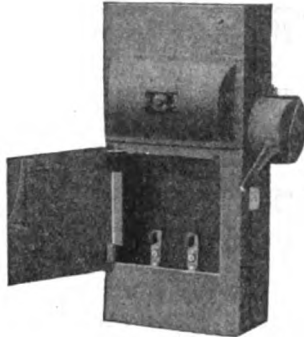
For Heavy Duty Service

Quick-Make and Quick-Break

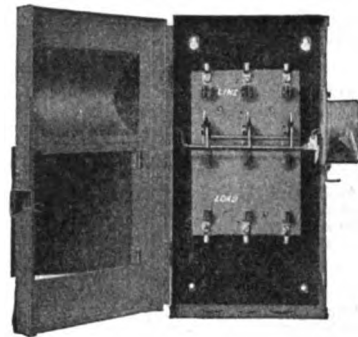
250 and 550 Volts A-C. or D-C.



100-AMPERE, 250-VOLT  
3-POLE  
DOORS CLOSED



100-AMPERE, 550-VOLT  
FUSE DOOR OPEN  
SWITCH LOCKED "OFF"



100-AMPERE, 250-VOLT, 3-POLE, OUTER  
DOOR OPEN SHOWING BLADES,  
TERMINALS AND KNOCKOUTS

The type WK-55 switches are of very rugged construction with **quick-make** and **quick-break** action designed to withstand the most severe service in industrial plants. While such service usually demands only disconnecting switches, the capacity and arcing arrangements in the type WK-55 are sufficient to enable the switch to break the locked current of alternating-current motors having full load current rating equal to that of the switch. Terminal screws are provided which may be used for making connections to compensator or in making load tests.

The quick-make and quick-break mechanism which operates the switch blades is enclosed in an external cast-iron hub or housing attached to the operating handle. This complete mechanism can be removed and replaced without disturbing the enclosed switch.

Over the fuse compartment is provided a door which is interlocked so that it may be opened only when the switch is in the "off" position at which time all reachable parts are dead. This door may also be locked so that only authorized persons have access to the fuses. Unfusible switches are not equipped with inner door. An outer door, provided with means for sealing or padlocking, opens over the whole front of the switch cabinet making it possible to inspect the switch while in operation or to make motorload test connections without stopping the motor. A three-hole bracket on the side of the cabinet permits the switch to be locked independently by three individuals.

**Knockouts**—Ends and sides of switch cabinets are equipped with knockouts making possible various conduit arrangements.

### LIST PRICES

Style numbers and list prices of switches do not include fuses or padlocks. Prices and data on extra heavy duty 2-pole switches for 250-volt series motor control will be furnished upon application.

Rating of Switch Amps.	ARC RUPTURING CAP. 15-SEC. INTERVALS		5-Second Rating Amperes	2-POLE		3-POLE		4-POLE	
	A-C. Amps.	D-C. Amps.		Style No.	List Price Each	Style No.	List Price Each	Style No.	List Price Each
<b>250 VOLTS FUSIBLE</b>									
30	175	45	1500	K-55100	\$19 00	K-55101	\$20 00	K-55102	\$25 00
60	300	90	3000	K-55103	21 00	K-55104	24 00	K-55105	30 00
100	300	..	4000	K-55106	35 00	K-55107	40 00	K-55108	45 00
200	300	..	6000	K-55109	44 00	K-55110	60 00	K-55111	65 00
<b>250 VOLTS UNFUSIBLE</b>									
30	175	45	1500	K-55010	18 00	K-55011	19 00	K-55012	24 00
60	300	90	3000	K-55013	20 00	K-55014	23 00	K-55015	28 00
100	300	..	4000	K-55016	33 00	K-55017	38 00	K-55018	43 00
200	300	..	6000	K-55019	41 00	K-55020	47 00	K-55021	62 00
<b>*550 VOLTS FUSIBLE</b>									
30	175	45	1500	K-55150	23 00	K-55151	25 00	K-55152	30 00
60	300	90	3000	K-55153	26 00	K-55154	30 00	K-55155	35 00
100	300	..	4000	K-55156	42 00	K-55157	48 00	K-55158	58 00
200	300	..	6000	K-55159	52 00	K-55160	59 00	K-55161	70 00
<b>*550 VOLTS UNFUSIBLE</b>									
30	175	45	1500	K-55050	22 00	K-55051	24 00	K-55052	29 00
60	300	90	3000	K-55053	25 00	K-55054	28 00	K-55055	33 00
100	300	..	4000	K-55056	40 00	K-55057	46 00	K-55058	56 00
200	300	..	6000	K-55059	50 00	K-55060	67 00	K-55061	68 00

\*These switches (550 volts) are equipped with an arc quenching barrier which accomplishes in an air-brake switch much that is accomplished by oil in an oil switch.

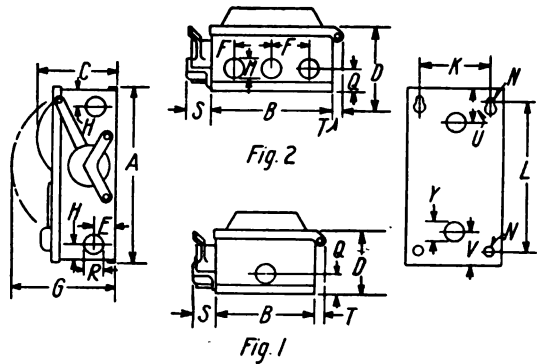
Order by Style Number

TYPE WK-55 INDUSTRIAL SAFETY SWITCH—Continued

Approximate Shipping Weight Each in Pounds

Table with columns: Rating of Switch, 2-Pole, 3-Pole, 4-Pole. Rows categorized by voltage (250V and 550V) and fuse type (FUSIBLE and UNFUSIBLE).

Outline Diagrams



Dimensions and Knockout Information

Large table with columns: Style No., No. of Poles, Amp. Cap., Fig. No., and dimensions A through Y. Rows list various switch models like K-55010, K-55016, K-55050, etc.



## SAFETY ENCLOSED AUTO-LOCK BRUSH TYPE SWITCHES

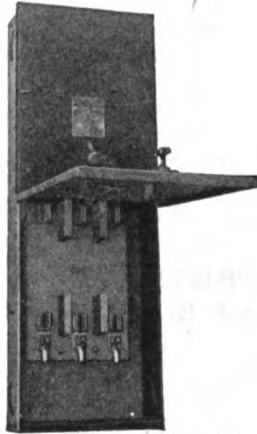
INDUSTRIAL SERVICE 250 VOLTS A-C OR D-C.—600 VOLTS A-C.

Capacities 30 to 1000 Amperes Inclusive  
Fusible and Unfusible

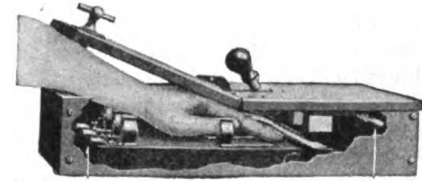
*Westinghouse Safety Enclosed Auto-Lock Switches are approved  
by the Underwriters' Laboratories under Classification "A"*



FRONT VIEW OF 30-AMPERE, 250-VOLT SAFETY ENCLOSED AUTO-LOCK SWITCH SHOWING SWITCH IN "OFF" POSITION.



200-AMPERE 250-VOLT SAFETY ENCLOSED AUTO-LOCK SWITCH WITH COVER OPEN—ALL PARTS EXPOSED ARE DEAD



THIS SIDE DEAD THIS SIDE ALIVE  
IMPOSSIBLE TO TOUCH LIVE PARTS



THIS SIDE MUST BE CONNECTED TO LOAD  
THIS SIDE MUST BE CONNECTED TO LINE  
CONTACTS CLOSED—COVER CANNOT BE OPENED

The Westinghouse safety enclosed auto-lock switch affords the highest degree of safety it is possible to obtain in any switch. It is fully 100 per cent safe because: (1) when the fuse door is open, every exposed part is dead; (2) this door cannot be opened until the switch is in the "off" position; (3) when the switch is thrown "on," the door is automatically locked; (4) the switch cannot be thrown "on" until the door is closed.

Yet this exceptional safety has not been attained at the expense of practicality or durability. The advantages of this switch in these respects also will be apparent after reading the paragraphs under "Distinctive Features" and "Construction."

### Application

Westinghouse safety enclosed auto-lock switches may be used as disconnecting switches wherever it is possible to apply the ordinary open-knife type of switch. They are particularly desirable in industrial plants, steam railroad shops, ship yards, mines and all places where persons are employed who have little or no knowledge of electricity and its attendant risk and where switches must be placed in exposed locations where they are liable to damage by loaded trucks or by heavy material being carried by employes.

### Distinctive Features

When the switch is in the "on" position, the

door over the fuse compartment is automatically locked.

The door may be locked shut with a padlock.

The switch may be locked in the "off" position, thereby assuring safety to workmen who may be required to make repairs to apparatus to which the switch is connected.

The moving contacts are of the laminated double-ended brush type which provides a double break, dividing the arc between the two ends.

When the brushes are thrown into contact, the operation spreads the brush leaves apart and each leaf makes its individual contact, thereby giving ample carrying capacity for much more than the rated current of the switch. The spreading of the brush also provides a wiping or self-cleaning action, which keeps the surface of both the brush ends and stationary contacts clean, and assures good contact at all times with an exceptionally low resistance.

All electrical or current-carrying parts of the switch are independent of the cover, as the bridge type of construction is used. This makes possible inspection of the brushes with perfect safety. Motor load testing is possible with this construction.

All switches are made with fuse holders at the bottom and the fuse holders are automatically made dead when the switch door is opened. This insures safety to the operator when changing fuses.

SAFETY ENCLOSED AUTO-LOCK BRUSH TYPE SWITCHES—Continued

Construction

Westinghouse safety auto-lock switches are enclosed in sheet steel boxes made of No. 12 gauge steel, thereby providing exceptional strength.

The stationary contacts are of hard-drawn copper, and with the fuse clips and terminals are mounted on slate bases free from metallic veins.

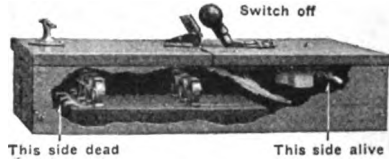
The moving contacts are laminated spring copper brushes, double-ended, with auxiliary arcing contacts at each end. Bronze outer leaves are provided for additional spring pressure.

The brushes in multipole switches are rigidly held together by being riveted through proper insulation to galvanized steel cross bars.

The movement is galvanized steel of toggle type, and is attached to the stationary end of the switch cover. It is easily removable for inspection by removing the top cover, which is held on by machine screws.

The insulation of the brushes from cross bar and

movement is water and acid-proof, and does not warp or shrink.



SWITCH LOCKED IN OPEN POSITION—COVER LOCKED SHUT

All fuse connections are provided for the use of N. E. C. enclosed fuses up to 600 amperes 3-pole inclusive. 600-ampere 4-pole switches and all other switches above 600 amperes are arranged to take copper link fuses.

The 600-volt switches for alternating-current service only are provided with slate barriers between opposite polarity. Dimensions are shown on page 1003.

Knockouts for conduit are provided in the ends and sides of each switch cabinet.

LIST PRICES

Safety Enclosed Auto-Lock Brush Type Switches

Style number and list price include switches complete ready for operation, but without fuses or padlocks. Switches with other than standard size or arrangement of conduit holes will be supplied on special order without extra price. Prices of 800 and 1000-ampere switches will be furnished on request.

Capacity Amperes	DOUBLE-POLE			THREE-POLE			FOUR-POLE		
	Style No.	Approx. Ship. Wt.	List Price	Style No.	Approx. Ship. Wt.	List Price	Style No.	Approx. Ship. Wt.	List Price
<b>250 Volts A-C. or D-C., Fused</b>									
30	K-37511	21 lbs.	\$ 17 00	K-37521	27 lbs.	\$18 00	K-37531	36 lbs.	\$ 27 00
60	K-37512	24 lbs.	19 00	K-37522	31 lbs.	21 00	K-37532	44 lbs.	31 00
100	K-37513	29 lbs.	30 00	K-37523	39 lbs.	35 00	K-37533	55 lbs.	40 00
200	K-37514	51 lbs.	40 00	K-37524	66 lbs.	44 00	K-37534	82 lbs.	60 00
400	K-37515	88 lbs.	60 00	K-37525	110 lbs.	75 00	K-37535	132 lbs.	98 00
600	K-37516	132 lbs.	90 00	K-37526	154 lbs.	115 00	K-54244*	181 lbs.	140 00
800*	K-37517	.....	.....	K-37527	.....	.....	K-37537	.....	.....
1000*	K-37518	.....	.....	K-37528	.....	.....	K-37538	.....	.....
<b>500-600 Volts A-C., Fused</b>									
30	K-53805	26 lbs.	22 00	K-53811	37 lbs.	24 00	K-53817	.....	32 00
60	K-53806	33 lbs.	24 00	K-53812	44 lbs.	28 00	K-53818	51 lbs.	35 00
100	K-53807	44 lbs.	37 00	K-53813	55 lbs.	42 00	K-53819	55 lbs.	47 00
200	K-53808	64 lbs.	50 00	K-53814	78 lbs.	55 00	K-53820	66 lbs.	65 00
400	K-53809	110 lbs.	80 00	K-53815	132 lbs.	95 00	K-53821	92 lbs.	110 00
600	K-53810	154 lbs.	110 00	K-53816	187 lbs.	135 00	K-53822*	220 lbs.	150 00
<b>250 Volts D-C. and 600 Volts A-C., Unfused</b>									
30	K-53823	21 lbs.	20 00	K-53829	27 lbs.	22 00	K-53835	36 lbs.	31 00
60	K-53824	24 lbs.	22 00	K-53830	31 lbs.	24 00	K-53836	44 lbs.	33 00
100	K-53825	25 lbs.	34 00	K-53831	32 lbs.	39 00	K-53837	45 lbs.	44 00
200	K-53826	37 lbs.	48 00	K-53832	49 lbs.	52 00	K-53838	64 lbs.	62 00
400	K-53827	66 lbs.	75 00	K-53833	83 lbs.	85 00	K-53839	110 lbs.	100 00
600	K-53828	93 lbs.	100 00	K-53834	115 lbs.	125 00	†K-53840	140 lbs.	140 00
800	†K-37597	.....	.....	†K-37607	.....	.....	†K-37617	.....	.....
1000	†K-37598	.....	.....	†K-37608	.....	.....	†K-37618	.....	.....

These switches will carry their rated current plus 50 per cent overload without undue heating. The 5-second rating of these switches is 20 times their normal rated capacity.

Prices for single-pole switches will be furnished on request.

\*Supplied with fuse connections for copper link fuses.

†Can be furnished only for 250 volts A-C.

For outline dimensions see following page.

Padlock for Use with Auto-Lock Switch

Description	Net Price
Yale and Towne Padlock No. 815, Bronze, with two Keys to Each Lock.....	\$25 00 Per Dos. 2 25 Each

Replacing Brushes for Auto-Lock Switches

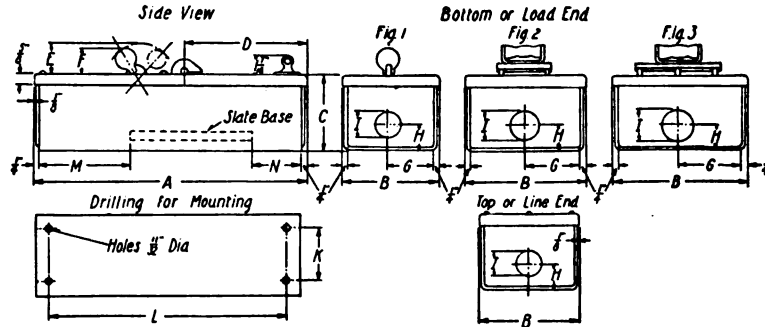
Style number and list price include laminated brushes complete with cross bars and saddles. The same brushes are used for fused and unfused switches for 250 or 600 volts.

Style No.	Amperes	Poles	List Price	Style No.	Amperes	Poles	List Price
K-52074	30 and 60	2	\$ 7 00	K-52082	200	2	\$13 00
K-52075	30 and 60	3	9 00	K-52083	200	3	16 00
K-52076	30 and 60	4	10 00	K-52084	200	4	20 00
K-52078	100	2	10 00	K-52086	400	2	16 00
K-52079	100	3	12 00	K-52087	400	3	22 00
K-52080	100	4	15 00	K-52088	400	4	35 00

Order by Style Number

SAFETY ENCLOSED AUTO-LOCK BRUSH TYPE SWITCHES—Continued

OUTLINE DIMENSIONS



Style No.	No. of Poles	Capacity Amp.	Fig. No.	DIMENSIONS IN INCHES													
				A	B	C	D	E	F	G	H	I	K	L	M	N	
K-37511	2	30	1	14	6 1/4	4 1/2	4 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	11 3/8	6 3/4	1 1/4	
K-37512	2	60	1	17	6 1/4	4 1/2	7 1/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	14 5/8	6 3/4	1 1/4	
K-37513	2	100	1	21 1/2	6 1/4	4 1/2	10 1/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	19 1/4	7 3/4	2 1/2	
K-37514	2	200	1	29 1/2	8	4 1/2	14 1/4	3 1/8	2 7/8	3 3/4	1 1/4	1 1/4	6	27 1/4	11 1/4	4 1/2	
K-37515	2	400	1	34	10 1/2	6 1/4	17 1/2	3 1/8	2 7/8	5	2 3/8	3	7 1/2	31 3/8	12 1/4	4 1/2	
K-37516	2	600	2	43 1/2	12 1/4	6 1/4	23 1/2	4 1/2	3 3/4	4 1/4	3 3/8	3 3/8	10 1/2	40 7/8	16 1/4	6 1/2	
K-37521	3	30	1	14	9 1/4	4 1/2	4 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	11 3/8	6 3/4	1 1/4	
K-37522	3	60	1	17	9 1/4	4 1/2	7 1/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	14 5/8	6 3/4	1 1/4	
K-37523	3	100	1	21 1/2	9 1/4	4 1/2	10 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	19 1/4	7 3/4	2 1/2	
K-37524	3	200	1	29 1/2	11	4 1/2	14 1/4	3 1/8	2 7/8	3 3/4	2 3/8	2 3/8	9	27 1/4	11 1/4	4 1/2	
K-37525	3	400	2	34	15	6 1/4	17 1/2	4 1/2	3 3/4	7 1/4	2 3/8	3	10 1/2	31 3/8	12 1/4	4 1/2	
K-37526	3	600	3	43 1/2	17	6 1/4	23 1/2	5 1/4	4 1/4	6 1/2	3 3/8	3 3/8	15	40 7/8	16 1/4	6 1/2	
K-37531	4	30	2	14	12 1/4	4 1/2	4 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	11 3/8	6 3/4	1 1/4	
K-37532	4	60	2	17	12 1/4	4 1/2	7 1/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	14 5/8	6 3/4	1 1/4	
K-37533	4	100	2	21 1/2	12 1/4	4 1/2	10 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	19 1/4	7 3/4	2 1/2	
K-37534	4	200	2	29 1/2	14	4 1/2	14 1/4	4 1/2	3 3/4	5	2 3/8	2 3/8	12	27 1/4	11 1/4	4 1/2	
K-37535	4	400	3	34	19 1/4	6 1/4	17 1/2	5 1/4	4 1/4	9 1/2	2 3/8	3 3/8	15	31 3/8	12 1/4	4 1/2	
K-53805	2	30	1	18 1/2	6 1/4	4 1/2	9 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	16 3/4	6 3/4	1 1/4	
K-53806	2	60	1	19 1/2	6 1/4	4 1/2	9 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	16 3/4	6 3/4	1 1/4	
K-53807	2	100	1	24	6 1/4	4 1/2	13 1/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	21 3/8	7 3/4	2 1/2	
K-53808	2	200	1	32 1/2	8	4 1/2	17 1/2	3 1/8	2 7/8	3 3/4	1 1/4	1 1/4	6	30 3/8	11 1/4	5 1/2	
K-53809	2	400	1	37	10 1/4	6 1/4	20 1/2	3 1/8	2 7/8	5	2 3/8	3	7 1/2	34 3/8	12 1/4	4 1/2	
K-53810	2	600	2	46 1/2	12 1/4	6 1/4	26 1/2	4 1/2	3 3/4	4 1/4	3 3/8	3 3/8	10 1/2	43 7/8	16 1/4	6 1/2	
K-53811	3	30	1	18 1/2	9 1/4	4 1/2	9 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	16 3/4	6 3/4	1 1/4	
K-53812	3	60	1	19 1/2	9 1/4	4 1/2	9 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	16 3/4	6 3/4	1 1/4	
K-53813	3	100	1	24	9 1/4	4 1/2	13 1/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	21 3/8	7 3/4	2 1/2	
K-53814	3	200	1	32 1/2	11	4 1/2	17 1/2	3 1/8	2 7/8	3 3/4	2 3/8	2 3/8	9	30 3/8	11 1/4	5 1/2	
K-53815	3	400	2	37	15	6 1/4	20 1/2	4 1/2	3 3/4	7 1/4	2 3/8	2 3/8	10 1/2	34 3/8	12 1/4	4 1/2	
K-53816	3	600	3	46 1/2	17	6 1/4	26 1/2	5 1/4	4 1/4	6 1/2	3 3/8	3 3/8	15	43 7/8	16 1/4	6 1/2	
K-53817	4	30	2	18 1/2	12 1/4	4 1/2	9 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	16 3/4	6 3/4	1 1/4	
K-53818	4	60	2	19 1/2	12 1/4	4 1/2	9 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	16 3/4	6 3/4	1 1/4	
K-53819	4	100	2	24	12 1/4	4 1/2	13 1/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	21 3/8	7 3/4	2 1/2	
K-53820	4	200	2	32 1/2	14	4 1/2	17 1/2	4 1/2	3 3/4	5	2 3/8	2 3/8	12	30 3/8	11 1/4	5 1/2	
K-53821	4	400	3	37	19 1/4	6 1/4	20 1/2	5 1/4	4 1/4	9 1/2	2 3/8	3 3/8	15	34 3/8	12 1/4	4 1/2	
K-53823	2	30	1	14	6 1/4	4 1/2	4 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	11 3/8	6 3/4	3 1/2	
K-53824	2	60	1	14 1/2	6 1/4	4 1/2	4 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	11 3/8	6 3/4	3 1/2	
K-53825	2	100	1	15 1/2	6 1/4	4 1/2	4 3/4	2 1/2	2 3/8	3	1 1/4	1 1/4	4 1/2	13 1/8	7 3/4	3 1/2	
K-53826	2	200	1	20 1/2	8	4 1/2	5 3/8	3 1/8	2 7/8	3 3/4	1 1/4	1 1/4	6	18 1/8	11 1/4	3 1/2	
K-53827	2	400	1	24 1/2	10 1/4	6 1/4	7 3/4	3 1/8	2 7/8	5 1/4	2 3/8	3	7 1/2	21 7/8	12 1/4	4 1/2	
K-53828	2	600	2	31 1/2	12 1/4	6 1/4	12	4 1/2	3 3/4	4 1/4	3 3/8	3 3/8	10 1/2	29 3/8	16 1/4	6	
K-53829	3	30	1	14	9 1/4	4 1/2	4 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	11 3/8	6 3/4	3 1/2	
K-53830	3	60	1	14 1/2	9 1/4	4 1/2	4 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	12 1/8	6 3/4	3 1/2	
K-53831	3	100	1	15 1/2	9 1/4	4 1/2	4 3/4	2 1/2	2 3/8	4 1/4	1 1/4	1 1/4	7 1/2	13 1/8	7 3/4	3 1/2	
K-53832	3	200	1	20 1/2	11	4 1/2	5 3/8	3 1/8	2 7/8	3 3/4	2 3/8	2 3/8	9	18 1/8	11 1/4	3 1/2	
K-53833	3	400	2	24 1/2	15	6 1/4	7 3/4	4 1/2	3 3/4	7 1/4	2 3/8	2 3/8	10 1/2	21 7/8	12 1/4	4 1/2	
K-53834	3	600	3	31 1/2	17	6 1/4	12	5 1/4	4 1/4	6 1/2	3 3/8	3 3/8	15	29 3/8	16 1/4	6	
K-53835	4	30	2	14	12 1/4	4 1/2	4 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	11 3/8	6 3/4	3 1/2	
K-53836	4	60	2	14 1/2	12 1/4	4 1/2	4 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	12 1/8	6 3/4	3 1/2	
K-53837	4	100	2	15 1/2	12 1/4	4 1/2	4 3/4	4 1/4	3 3/8	6	1 1/4	1 1/4	10 1/2	13 1/8	7 3/4	3 1/2	
K-53838	4	200	2	20 1/2	14	4 1/2	5 3/8	4 1/2	3 3/4	5	2 3/8	2 3/8	12	18 1/8	11 1/4	3 1/2	
K-53839	4	400	3	24 1/2	19 1/4	6 1/4	7 3/4	5 1/4	4 1/4	9 1/2	2 3/8	3 3/8	15	21 7/8	12 1/4	4 1/2	
K-54244	4	600	2	47 1/2	22 1/4	8 3/4	17 3/4	7	5 1/2	11	4 1/4	4 1/4	14	39	16 1/4	9 1/2	
*3		800															
*3		1000															
*3		1200															
*3		1500															

These dimensions are for reference only. For official dimensions apply to nearest district office. \*Dimensions will be furnished on request.

Order by Style Number

# SAFETY MINE DISCONNECTING SWITCHES

600 VOLTS

SINGLE-POLE UNFUSED BRUSH-TYPE

For A-C. or D-C. Circuits

The safety mine disconnecting switches have all the features of the safety enclosed auto lock switches and are mounted in cast iron boxes to withstand the severe atmospheric conditions prevalent in underground service. They are gas and vapor proof. They may be made water-proof by the use of rubber gaskets under the box cover, at an additional charge of 10 per cent to the list price of switch.

mechanism is operated independently of the switch handle, it is impossible to retard the quick-break of the switch contacts.

## Construction

The handle of the switch is removable only in the "OFF" position, thus compelling the operator to throw-off the switch in order to turn in the handle when leaving the mine.

The box is painted inside with P. and B. paint.

The switch blades are of the laminated type, mounted on a very heavily insulated carrier, and make contact with flat stationary copper terminals. The switch carrier is supported by a steel bracket which is mounted on a one-inch slate base, thereby increasing the insulation between the switch blades and the box.

All switches are of the double-break quick-break type and are equipped with arcing tips. Since the



SAFETY MINE DISCONNECTING SWITCH  
600 AMPERE CAPACITY

The brushes are easily removed for repair or replacement without disturbing the conduit or switch parts, by removing the two screws which clamp the brush to the crossbar.

## LIST PRICES

Capacity Amperes	Poles	Volts	Style No.	List Price
100	1	600	K-52518	\$60 00
200	1	600	K-52519	75 00
400	1	600	K-52520	90 00
600	1	600	K-52521	150 00
800	1	600	K-54793	380 00
1000	1	600	K-54794	550 00
*1200	1	600	K-54795	.....

\*Price of 1200-ampere switch will be furnished on request.  
These switches will carry their rated current plus 50 per cent overload without undue heating.

## APPROXIMATE DIMENSIONS AND WEIGHTS

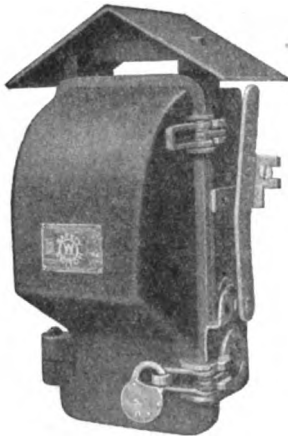
Capacity Amperes	OUTSIDE DIMENSIONS IN INCHES			APPROXIMATE WEIGHTS, POUNDS	
	Length	Width	Depth	Net	Shipping
100	23	9	6	57	75
200	23	9	6	57	75
400	26 1/4	10 3/4	6	75	95
600	26 1/2	10 3/4	6	87	105
800	26 1/2	10 3/4	6	95	115
1000	26 1/2	10 3/4	6	100	120
1200	26 1/2	10 3/4	6	105	125

Fused switches and two or three-pole switches for this service are special and prices will be quoted on request.  
When 250-volt mine switches are required the prices listed above will apply.

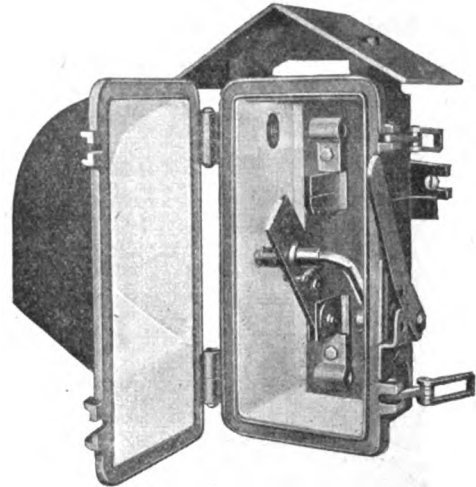
Order by Style Number

## SAFETY ORE-MINE SWITCHES

### KNIFE-TYPE



OUTSIDE VIEW OF ORE-MINE SWITCH



INSIDE VIEW OF ORE-MINE SWITCH

This is an ideal safety switch for ore-mine use where the voltage is 250 volts direct current or 500 volts alternating current. It is a knife switch somewhat different from the "mine-type" disconnecting switch shown on the previous page, enclosed in a cast iron water-proof box with a shed top to protect the box against "drip."

#### Construction

Two coats of P. and B. paint are given the box both inside and out and for further insulation it is lined with asbestos paper. Two ice-box type catches clamp down the cover against a rubber gasket.

The galvanized steel handle is mounted on the outside of the box and can be locked in the "off" position; it is directly connected to the yoke of the switch. All bolts and rivets inside and outside of the box are brass or bronze so that the possibility of rust or corrosion has been reduced to a minimum. The switch is of the knife type, quick-break, mounted on a slate base with wire terminals, top and bottom.

These switches have been developed for only capacities listed below. Other sizes can be completed for orders where the quantity would warrant such development.

#### Single-Pole Single-Throw Unfused

Capacity Amperes	Volts	Net Weight, Lbs.	Style No.	List Price
200	{ 250 d-c. }	65	K-52350	\$60 00
	{ 500 a-c. }			
400	{ 250 d-c. }	70	K-52227	70 00
	{ 500 a-c. }			

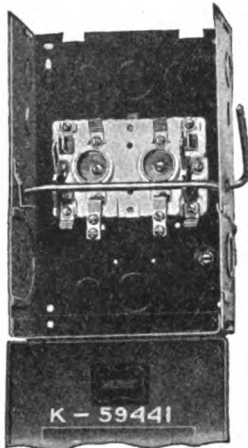
These switches will carry their rated current plus 50 per cent overload without undue heating.

Order by Style Number

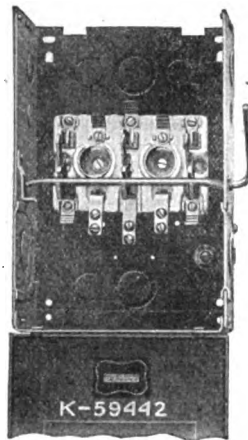
## METER SERVICE SWITCHES TYPE WK-54

### METER SERVICE DEVICES

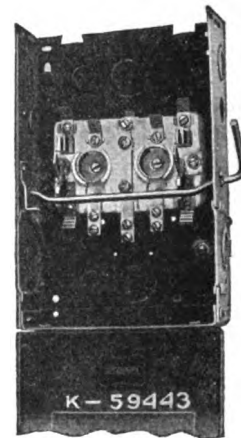
Standardized Safety Cabinets Meter Service Switches  
Main Entrance Switches Meter Test Blocks Meter Service Cutouts  
Standard Meter Service Switches with External Handle



30-AMPERE, 125-VOLT (2-wire)  
TYPE WK-54 METER SERVICE  
SWITCH WITH TESTING  
FACILITIES—STYLE K-59441



30-AMPERE, 125-250 VOLT (3-wire)  
TYPE WK-54 METER SERVICE  
SWITCH WITH TESTING  
FACILITIES—STYLE K-59442



30-AMPERE, 125-250 VOLT  
(3-wire) TYPE WK-54 METER  
SERVICE SWITCH WITH TESTING  
FACILITIES—STYLE K-59443

Westinghouse Type WK-54 Meter Service Switches and standardized meter service devices meet the demand of central stations and power companies for an inexpensive meter switch which will permit of testing the subscriber's meter without interrupting his service.

To mount switches in banks, troughs with covers can be furnished in standard lengths. In the lower part of each switch side wall there is a U-shaped slide, held in place by a grounding screw. This slide may be removed and replaced at will on all switches of 30-ampere capacity. These U-slides provide openings for wiring troughs when meters are banked, or for fuse cut-out blocks for branch circuits. The switches are also equipped with knockouts for conduit which may be used in banking.

An inside locking device enables lighting companies to lock the switch handle in the "On" or

"Off" position, disconnecting or locking the service without removing the meter.

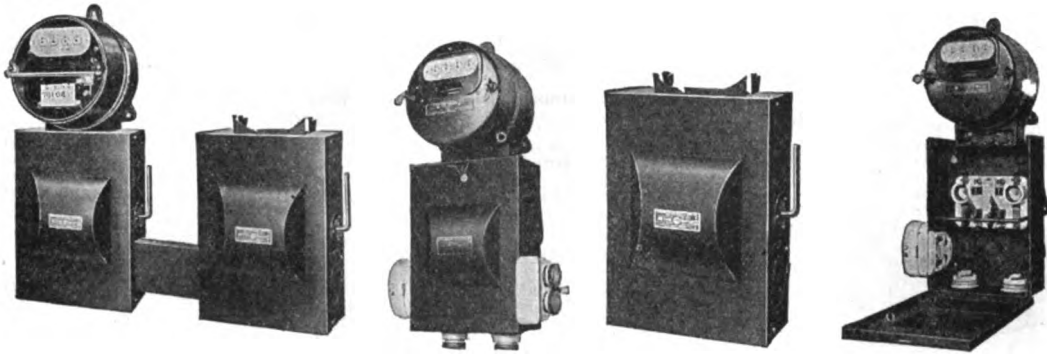
Twin fuse receptacles may be mounted in the side wall to provide branch fuses, externally accessible to the customer.

**Cabinets:** The cabinets of Type WK-54 switches are made of No. 16 gauge steel. The cover is held in place with a meter seal, which prevents theft of current and at the same time rigidly holds the box in locked assembly. Different makes of meters require different trims. Therefore the standard switch will be packed complete without the meter trim which must be ordered separately as required to fit the meters. Both ends of the cabinets are interchangeable, making it possible to use it with either top or bottom connected meters. Blank ends and meter trims are interchangeable with ends and trims of standardized cabinets of similar ratings and capacity. The cabinet is provided with a varied assortment of knockouts.

### LIST PRICES (STANDARD TYPES)

The style numbers and list prices of these switches do not include fuses, meter trims, end walls, banking troughs, etc. End walls, meter trims, etc. are listed separately on page 1008.

TYPE WK-54 METER SERVICE SWITCHES—Continued



SHOWING METHOD OF BANKING  
TYPE WK-54 SWITCHES

ARRANGED FOR  
THREE BRANCH  
CIRCUITS

TYPE WK-54 SWITCH  
WITHOUT METER BUT  
WITH METER TRIM

ARRANGED FOR  
TWO BRANCH  
CIRCUITS

LIST PRICES (STANDARD TYPES)—Continued

WK-54 Meter Service Switches

(Without End Walls—With Testing Facilities)

Style No.	Amperes	Volts	Service	Arranged for	Approx. Ship. Wt. Each, Lbs.	List Price Each
K-80224	30	125	2-wire	1 plug fuse, 2 switch blades, 1 solid connection	10	\$5 10
K-59441	30	125	2-wire	2 plug fuses, 2 switch blades	10	6 10
K-59442	30	125-250	3-wire	2 plug fuses, 3 switch blades	10	6 85
K-80225	30	125-250	3-wire	2 plug fuses, 2 switch blades, 1 disconnect blade	10	6 85
K-59443	30	125-250	3-wire	2 plug fuses, 2 switch blades, 1 disconnect strap	10	6 85
K-80226	30	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	10	5 10
K-59447	30	250	2-wire	2 N. E. C. fuses, 2 switch blades	10	5 10
K-59448	30	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	10	6 85
K-80227	30	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	10	6 85
K-59449	30	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect strap	10	6 85
K-80228	60	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	16	12 10
K-59461	60	250	2-wire	2 N. E. C. fuses, 2 switch blades	16	12 10
K-59462	60	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	16	13 30
K-80229	60	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	16	13 30
K-80230	60	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 link	16	13 30
K-80231	100	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	28	19 80
K-59463	100	250	2-wire	2 N. E. C. fuses, 2 switch blades	28	19 80
K-59464	100	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	28	21 80
K-80232	100	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	28	21 80
K-80233	100	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 link	28	21 80

WK-54 Main Entrance Switches—Straight Through Type

(Without End Walls—With No Testing Facilities)

Style No.	Amperes	Volts	Service	Arranged for	Approx. Ship. Wt. Each, Lbs.	List Price Each
K-80234	30	125	2-wire	1 plug fuse, 2 switch blades, 1 solid connection	10	\$5 10
K-59444	30	125	2-wire	2 plug fuses, 2 switch blades	10	5 10
K-59445	30	125-250	3-wire	2 plug fuses, 3 switch blades	10	6 85
K-80235	30	125-250	3-wire	2 plug fuses, 2 switch blades, 1 disconnect blade	10	6 85
K-80236	30	125-250	3-wire	2 plug fuses, 2 switch blades, 1 disconnect link	10	6 85
K-80237	30	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	10	5 10
K-59450	30	250	2-wire	2 N. E. C. fuses, 2 switch blades	10	5 10
K-80238	30	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	10	6 85
K-59451	30	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	10	6 85
K-80239	30	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect link	10	6 85
K-80240	60	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	16	12 10
K-59452	60	250	2-wire	2 N. E. C. fuses, 2 switch blades	16	12 10
K-59453	60	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	16	13 30
K-80241	60	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	16	13 30
K-80242	60	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect link	16	13 30
K-80243	100	125	2-wire	1 N. E. C. fuse, 2 switch blades, 1 solid connection	28	19 80
K-59454	100	250	2-wire	2 N. E. C. fuses, 2 switch blades	28	19 80
K-59455	100	125-250	3-wire	2 N. E. C. fuses, 3 switch blades	28	21 80
K-80244	100	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect blade	28	21 80
K-80245	100	125-250	3-wire	2 N. E. C. fuses, 2 switch blades, 1 disconnect link	28	21 80

Meter Trims and End Walls for Above Switches are listed on page 1008

Order by Style Number

TYPE WK-54 METER SERVICE SWITCHES—Continued

ACCESSORIES

Style No.	Description	Standard Pkg. Quan.	List Price Each
<b>Meter Trims for 30-Ampere Switches—2 or 3 Wire</b>			
K-55270	For Westinghouse OA meter, 5-10 amps. For meter without terminal cover.....	30	\$0 40
K-57221	For Westinghouse OA meter, 5-10 amps. For meter with terminal cover.....	30	40
K-55271	For Westinghouse OA meter, 15-80 amps. For meter without terminal cover.....	30	40
K-55272	For General Electric I-14 meter, 5-25 amps.....	30	40
K-55273	For Sangamo H-2 (new model) meter, 5-15 amps.....	30	40
K-59330	For Duncan M-2 meter, 5-25 amps..... 2 or 3-wire.....	30	40



Blank End Walls for 30-Ampere Switches—2 or 3 Wire

K-55269	Two 1/2-inch, one combination 1/2-inch 3/4-inch knockouts.....	30	40
K-57047	Two 3/4-inch, one combination 1-inch 1 1/4-inch knockouts.....	30	40

Meter Trims for 60-Ampere Switches—2 or 3 Wire

K-57047			
K-57165	For Westinghouse OA meter, 15-75 amps.....	10	90
K-57166	For General Electric I-14 meter, 30-75 amps.....	10	90
K-57167	For Sangamo H-2 (new model) meter, 25-100 amps.....	10	90
K-60335	For General Electric I-14 meter, 5-25 amps.....	10	90

Blank End Wall for 60-Ampere Switches—2 or 3 Wire

K-56950	Four Combination 3/4-inch 1-inch knockouts.....	10	90
K-57066	One 1-inch and one combination 1 1/4-inch 1 1/2-inch knockouts.....	10	90

Meter Trims for 100-Ampere Switches—2 or 3 Wire

K-57171	For Westinghouse OA meter, 15-75 amps.....	4	1 10
K-57172	For General Electric I-14 meter, 30-75 amps.....	4	1 10
K-57173	For Sangamo H-2 (new model) meter, 25-100 amps.....	4	1 10

Blank End Wall for 100-Ampere Switches—2 or 3 Wire

K-56952	Four combination 3/4-inch 1-inch knockouts.....	4	1 10
K-57067	One combination 1-inch 1 1/2 inch knockout and one combination 2-inch 2 1/2-inch knockout.....	4	1 10

Troughs and Covers for Banking 30-Ampere Cabinets

Style No.	Length in inches	Standard Pkg. Quan.	List Price Complete	Style No.	Length in inches	Standard Pkg. Quan.	List Price Complete
K-55275	4 1/4	50	\$0 80	K-57179	8	50	\$0 95
K-55276	2 1/2	50	75	K-60314	9	50	95
K-57178	6	50	90	K-60315	10	50	1 05



Style No.	Description	Standard Pkg. Quan.	List Price Each
K 60278	For 31— 60-ampere switches.....	50	\$1 15
K-60279	For 61—100-ampere switches.....	50	1 15

U-Slides for 30-Ampere Cabinets

K-55244	One 1 1/4-inch knockout.....	50	40
K-55567	One combination 3/4-inch 1-inch knockout.....	50	40



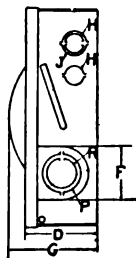
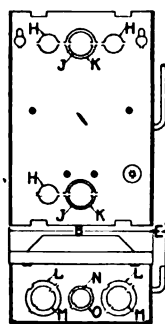
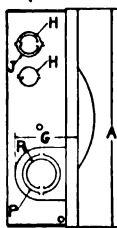
Distribution Cutout Block

Style No.	Description	Standard Pkg. Quan.	List Price Each
K-57252	For customer's circuit.....	50	\$1 40

Outline Dimensions Type WK-54 Switch

(Standard Type)

0-30-Amperes, 125 and 250 Volts, 2 or 3 Wire



- 2 and 3 Wire
- A 10 1/4 inches
- B 6 1/4 inches
- C 4 1/4 inches
- D 3 3/4 inches
- E 3/4 inch
- F 2 1/2 inches
- G 3 inches
- H 1/2 inch knockout
- I 1/2 inch knockout
- J 1/4 inch knockout
- K 1 1/2 inch knockout
- L 2 Wire
- M 3/4 inch
- N 1/2 inch
- O 3/4 inch
- P 1 1/4 inch
- Q 3/4 inch
- R 3 Wire
- M 1 1/4 inch
- N 3/4 inch
- O 1 inch
- P 1 inch
- R 3/4 inch



K-57252

The above Accessories can be used on Standardized Service Entrance Switches listed on Pages 1007, 1010 and 1011.

Order by Style Number



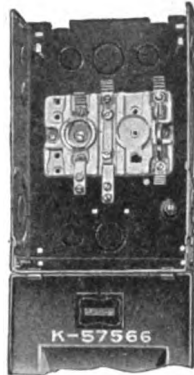
TYPE WK-54 METER SERVICE SWITCHES—Continued

SPECIAL METER SERVICE DEVICES (COMMONWEALTH TYPE)  
FOR CHICAGO

Devices with and without External Handle  
Switches—Cutouts—Test Blocks—Accessories



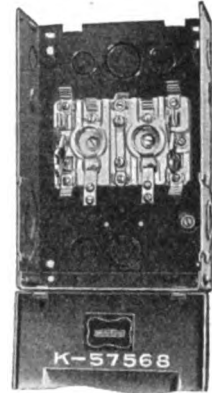
30-AMPERE, 125-VOLT, (2-WIRE) CHICAGO TYPE WK-54 METER SERVICE SWITCH—STYLE K-57565



30-AMPERE, 125-VOLT, (2-WIRE), CHICAGO TYPE METER SERVICE CUTOUT—STYLE K-57566



30-AMPERE, 125-250 VOLT, (3-WIRE), CHICAGO TYPE WK-54 METER SERVICE SWITCH—STYLE K-57567



30-AMPERE, 125-250 VOLT, (3-WIRE), CHICAGO TYPE METER SERVICE CUTOUT—STYLE K-57568

Style No.	Amps.	Volts	Service	Testing Facilities	*End Wall	Arranged for	Approx. Shipping Wt. Lbs.	List Price Each With End Wall
<b>Meter Service Switches with External Handle—For Single Consumer's Installation</b>								
K-60187	30	125	2-wire	Yes	Shutter type	1 test blade, 2 switch blades, 1 plug fuse	10	\$6 10
K-57566	30	125	2-wire	Yes	Shutter type	1 test blade, 1 switch blade, 1 solid neutral, 1 plug fuse	10	5 50
K-57567	30	125-250	3-wire	Yes	Shutter type	2-blade test block, 2 switch blades, 2 plug fuses, 1 solid neutral	10	6 95
K-60188	30	250	2-wire	Yes	Shutter type	2 switch blades, 2 N. E. C. fuses, 1 test blade	10	6 10
<b>Meter Service Cutouts without External Handle—For Banked Installation</b>								
K-57566	30	125	2-wire	Yes	Shutter type	1 test blade, 1 solid neutral, 1 plug fuse	10	5 05
K-57568	30	125-250	3-wire	Yes	Shutter type	2 test blades, 1 solid neutral, 2 plug fuses	10	5 85
K-60186	30	250	2-wire	Yes	Shutter type	1 test blade 2 N. E. C. fuses	10	5 45
<b>Meter Test Blocks without External Handle—For Single Consumer's Installation</b>								
K-57577	30	250	2 or 3 wire	Yes	Shutter type	4 test blades, 1 solid neutral, no fuses	10	6 00
K-57578	60	250	2 or 3 wire	Yes	Shutter type	4 test blades, 1 solid neutral, no fuses	16	14 20
K-57579	100	250	2 or 3 wire	Yes	Shutter type	4 test blades, 1 solid neutral, no fuses	28	23 10
<b>Main Entrance Switches with External Handle—Single Phase and Direct Current</b>								
K-60199	30	250	2-wire	No	Solid	2 N. E. C. fuses on switch blades	10	6 40
K-60200	30	250	3-wire	No	Solid	2 N. E. C. fuses on switch blades, 1 solid neutral link	10	7 40
K-60201	60	250	2-wire	No	Solid	2 N. E. C. fuses on switch blades	16	15 40
K-60202	60	250	3-wire	No	Solid	2 N. E. C. fuses on switch blades, 1 solid neutral link	16	16 90
K-60203	100	250	2-wire	No	Solid	2 N. E. C. fuses on switch blades	28	25 10
K-60204	100	250	3-wire	No	Solid	2 N. E. C. fuses on switch blades, 1 solidneutral link	28	27 60
<b>Main Entrance Switches with External Handle—Three Phase</b>								
K-60205	30	250	3-wire	No	Solid	3 N. E. C. fuses on switch blades	10	8 40
K-60206	60	250	3-wire	No	Solid	3 N. E. C. fuses on switch blades	16	17 90
K-60207	100	250	3-wire	No	Solid	3 N. E. C. fuses on switch blades	28	31 10

\*Style Number and List Price of Switch Includes End Wall. Trims for WK-54 Commonwealth Type Switches are Listed on Page 1010

Order by Style Number

TYPE WK-54 METER SERVICE SWITCHES—Continued

SPECIAL METER SERVICE DEVICES (COMMONWEALTH TYPE)  
FOR CHICAGO—Continued

ACCESSORIES

Meter Trims, End Walls, Etc.

For 30-Ampere Switches of the following types: K-60187,  
K-57565, K-57567, K-60188, K-57566, K-57568, K-60186,  
K-57577, K-60199, K-60200, K-60205

Style No.	Description	List Price
K-59431	End wall for 30-ampere cabinet for insulating shutter trim.....	\$0 40
K-59432	Shutter trim for Sangamo type H-2 meters, 25 to 100 amperes.....	17
K-59433	Shutter trim for G. E. I-14 meters, 5 to 25 amperes.....	17
K-59434	Shutter trim for Westinghouse OA meters, 0 to 10 amperes.....	17
K-59435	Shutter trim for Westinghouse OA meters, 15 to 75 amperes.....	17
K-59436	Shutter trim for Sangamo type H-2 meters (new), 5 to 15 amperes.....	17
K-59437	Shutter trim for Duncan type M-2 meters, 5 to 25 amperes.....	17
K-59438	Shutter trim for Sangamo type H meters (old), 5 to 15 amperes.....	17
K-59440	Insulating strip to insulate meter terminal chamber from back of cabinet.....	10
K-60214	Inner slide for adaptor coupling.....	17
K-60215	Outside separator for adaptor coupling.....	28
K-55269	End wall (one piece).....	40
K-60181	Steel shutter for standardized end wall.....	25

For 60 and 100-Ampere Switches of the following types: K-57578  
K-57579, K-60201, K-60202, K-60203, K-60204, K-60206, K-60207

K-60216	Shutter trim for G. E. I-14 meters, 50 to 75 ampere (60 and 100-ampere switches).....	28
K-60217	Shutter trim for Westinghouse OA meters, 15 to 75 amperes (60 and 100-ampere switches).....	28
K-60218	Shutter trim for Sangamo type H-2 meters (new), 25 to 100 amperes (60 and 100-ampere switches).....	28
K-60219	Inner slide for adaptor coupling (60 and 100 ampere switches).....	28
K-60221	Insulating strip to insulate meter terminal chamber from back of cabinet (60 and 100-ampere switches).....	17
K-60184	End wall, shutter type (60-ampere switches).....	90
K-60185	End wall, shutter type (100-ampere switches).....	1 30
K-58950	End wall (one piece) (60-ampere switches).....	90
K-57067	End wall (one piece) (100-ampere switches).....	1 10
K-60183	Steel shutter for standardized end wall (60 and 100-ampere switches).....	25

SPECIAL METER SERVICE DEVICES FOR DETROIT  
AND CLEVELAND TERRITORIES

Meter Service Switches—Standardized Safety Cabinets

(Without End Walls—With Testing Facilities)

Style No.	Amps.	Volts	Service	Arranged for	Approx. Ship. Ea., Lbs.	Each (without End Wall)	List Price
K-60253	30	125	2-wire	1 plug fuse, 2 switch blades, 1 solid connection.....	10	\$ 5 10	
*K-60333	30	125	2-wire	2 plug fuses, 2 switch blades.....	10	5 10	
K-60254	30	125-250	3-wire	2 plug fuses, 3 switch blades.....	10	5 85	
*K-60336	30	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	10	5 85	
K-60255	30	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	10	5 10	
K-60256	60	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	16	12 10	
K-60257	60	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	16	13 30	
K-60258	100	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	28	19 80	
K-60259	100	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	28	21 80	

Main Service Entrance Switches—Straight Through Type

(No Testing Facilities)

K-60260	30	125	2-wire	1 plug fuse, 2 switch blades, 1 solid connection.....	10	5 10
*K-60334	30	125	2-wire	2 N. E. C. fuses, 2 switch blades.....	10	5 10
K-60261	30	125-250	3-wire	2 plug fuses, 3 switch blades.....	10	5 95
K-60331	30	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	10	5 10
K-60262	30	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	10	5 85
K-60263	60	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	16	12 10
K-60264	60	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	16	13 30
K-60265	100	250	2-wire	2 N. E. C. fuses, 2 switch blades.....	28	19 80
K-60332	100	125-250	3-wire	2 N. E. C. fuses, 3 switch blades.....	28	21 80

\*These switches are special for Cleveland (Ohio) Territory.  
These special switches for Detroit and Cleveland territories are the same as standard type WK-54 switches except that they are equipped with outside grounding lug and outside lockoff arrangement.

For end walls and meter trims see page 1008. These are NOT included in list prices of above switches.

Order by Style Number

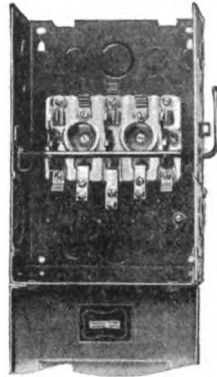
TYPE WK-54 METER SERVICE SWITCHES—Continued

SPECIAL METER SERVICE DEVICES FOR BOSTON  
(EDISON ELECTRIC ILLUMINATING COMPANY)

Meter Service Switches

Standardized Safety Cabinets

Without End Walls



STYLE K-60246

These Meter Service Devices are of the same construction as the Standard type except that they are equipped with a "lock on" bracket on the outside of the cabinet and a special ground lug on the inside of the cabinet. The 30-ampere size also differs slightly from the standard type, in that the "U" slide is equipped with a combination one inch and one and one quarter inch knockout.

They are arranged for two or three wire grounded neutral service adaptable to standard end walls or meter trims and are used on the lines of the

Edison Electric Illuminating Company, Boston, Mass.

In banked installations a main entrance switch is required to control the entire supply.

On the 30-ampere capacity switch the neutral blade cannot be opened until after the switching blades are opened. It is arranged to close with the switch.

The 60- and 100-ampere capacities have the neutral arranged for a disconnect link which is opened and closed independent of the switch blades.

Style No. Switch Only	Amps.	Volts	Service	Test Blades	Fuses	No. of Switch Blades	Approx. Ship. Wt., Ea., Lbs.	List Price Each
K-80246	30	125-250	2 or 3-wire	1 Test	2 Plug	2	10	\$ 5 85
K-80247	60	125-250	2 or 3-wire	1 Link	2 N. E. C.	2	16	13 30
K-80248	100	125-250	2 or 3-wire	1 Link	2 N. E. C.	2	28	21 80
K-80252	30	250	2-wire only	None	2 N. E. C.	2	10	5 10
K-80351	60	250	2-wire only	None	2 N. E. C.	2	16	12 10
K-80352	100	250	2-wire only	None	2 N. E. C.	2	28	19 80

Meter Trims, End Walls and Accessories for Above Switches are Listed on Page 1008

Style No.	Description	List Price Each
K-80280	60-Ampere Bussing Lug .....	\$0 12

Main Entrance Switches—Straight Through Type  
(Without End Walls)

Style No. Switch Only	End Wall	Amps.	Volts	Service	Fuses	No. of Switch Blades	Neutral Arrangement	Approx. Ship. Wt. Ea., Lbs.	List Price Each
K-54615	K-57047	30	125-250	2 or 3-wire	2 Plug	2	1 Disc. Blade	10	\$ 5 85 40
K-80249	K-57066	60	125-250	2 or 3-wire	2 N. E. C.	2	Link	16	13 30 90
K-80250	K-57067	100	125-250	2 or 3-wire	2 N. E. C.	2	Link	28	21 80 1 10

The above switches are standard for use on either 2 or 3-wire main entrances.

The Following Switch Can Also be Furnished Where Required

K-80251	K-57047	30	125-250	2 or 3-wire	2 N. E. C.	2	Link	10	5 85 40
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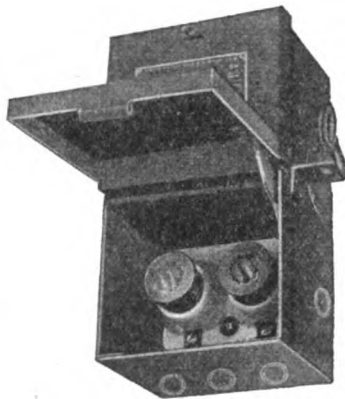
These switches are provided with a bracket mounted on the outside of the cabinet to lock the switch in the closed position. They are also provided with a neutral disconnecting link which makes it possible to use a two-wire switch on either a two-wire circuit or a three-wire circuit.

Order by Style Number

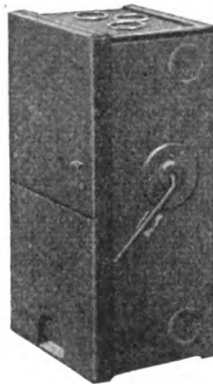
## FULL SAFETY SERVICE SWITCHES TYPE WK-53

Capacities 30, 60 and 100 Amperes 125 and 250 Volts

Two and Three-Pole



30-AMPERE 125-VOLT 2-POLE  
FUSE COMPARTMENT COVER OPEN  
SHOWING BARRIER



30-AMPERE 125-VOLT  
2-POLE WITH BLANK  
END STYLE K-52033



30-AMPERE 125-VOLT 3-POLE  
SHOWING FUSE COMPARTMENT  
AND BARRIER

Westinghouse Type WK-53 Full Safety Switches meet the increasing demand for a 100 per cent safety switch for both service meter protection and safety industrial disconnect purposes.

These switches are of the knife type, externally operated, with the fuse chamber isolated from all live contacts when the fuse chamber cover is open and the switch is in the "OFF" position.

Because the fuse chamber is inaccessible when the switch is in the "ON" position, the operator is fully protected against injury due to electrical shock.

### Construction

The 30 ampere type of switch, which may be furnished with various types of ends, is equipped with a barrier between the switch and fuse chamber making it impossible to get at live parts when the fuse chamber cover is open. This switch cannot be closed while the cover is open.

The 60 and 100 ampere types have solid bottoms, the top ends being fitted with a removable end plate to allow the use of the type of meter trim desired. These switches are of the double door construction; the outer door covering the complete switch is arranged for sealing or locking; the inner door, which is over the fuse chamber, is interlocked with the switch so that it is impossible to open it while the switch is "ON."

Provision is made for sealing the cover so that none but authorized persons may have access to the switch mechanism.

Improved knockouts are provided in each cabinet to accommodate the standard sizes of conduit.

The workmanship and finish of these switches are of the highest standard.

### Accessories

It is often desired to combine a customer's fuse compartment equipped with a double branch cutout block for circuit fusing. This can be accomplished with Style K-53050 30-ampere Switch and the use of Fuse Compartment Style K-59301 the cover of which interlocks with that of the switch. Style K-57058 is adaptable for main line fuses on Switch Style K-53002, permitting the switch compartment fuse to be used as a branch circuit. Both fuse compartment covers have provisions for sealing to prevent unauthorized entrance.

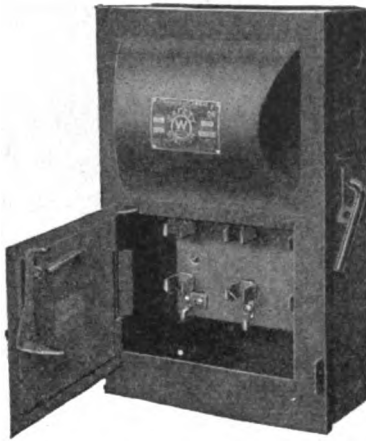
For use with Westinghouse Type OA Meters the Meter Junction Box is used where meter mounting space with a switch is at a minimum, and where the requirements to mount the meter are remote from the switch.

The cover is held in place by a thumb screw on the bottom and a wing nut screwed on to the stud of

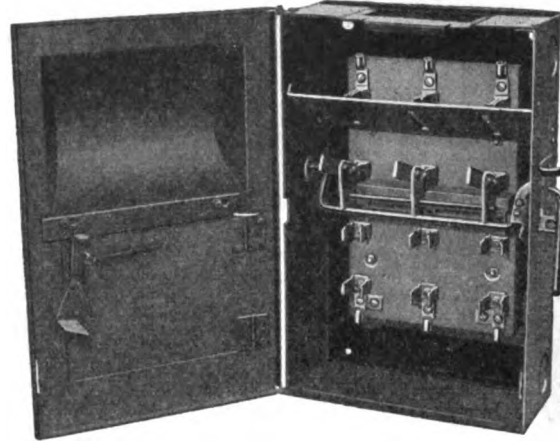


60-AMPERE 250-VOLT 3-POLE  
STYLE K-53010

TYPE WK-53 SAFETY SERVICE SWITCHES—Continued



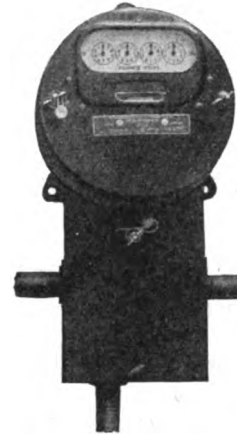
STYLE K-53010. SWITCH "OFF,"  
INNER DOOR OPEN SHOWING  
FUSE COMPARTMENT



STYLE K-53010. OUTER DOOR  
OPEN SHOWING FUSE COM-  
PARTMENT AND BARRIER

the meter terminal chamber which protrudes through the front. Seals can be inserted into holes of the stud and wing nut. An ample number of 1/2 and 3/4-inch combination knockouts are provided for conduit outlets.

This meter junction box is listed below. End walls, meter trims, fuse compartments and other accessories for Type WK-53 switches are listed on page 1014.



METER JUNCTION BOX, STYLE K-57469, SHOWING METER  
AND CONDUIT ARRANGEMENT. NO INTERIOR  
WIRING DEVICE NECESSARY

LIST PRICES

Style number and list price of switches do not include fuses; 125-volt switches are arranged for plug fuses; 250-volt switches are arranged for N. E. C. fuses.

WK-53 Safety Service Switches

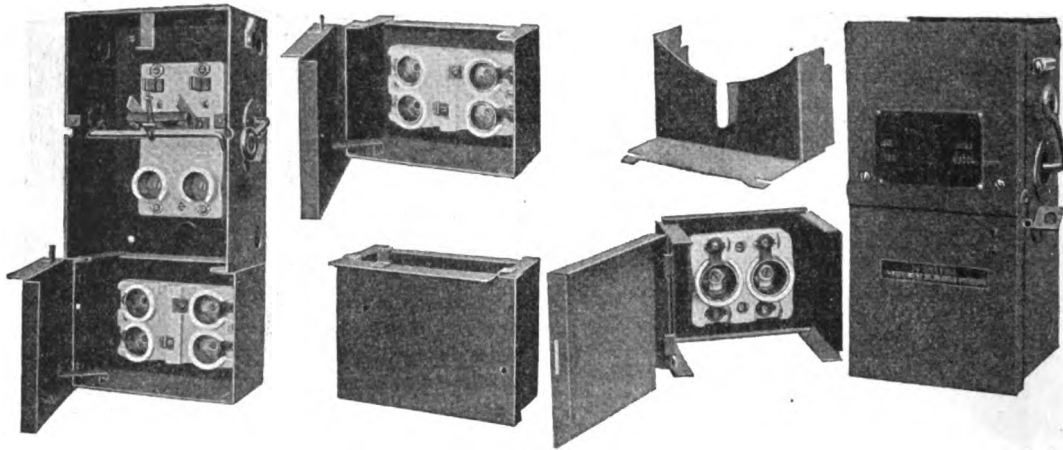
Style No.	Amps	Volts	Poles	SIZE OF BOX, INCHES			Description	Approx. Ship. Wt. Ea., Lbs.	List Price Each
				Length	Width	Depth			
K-53000A	30	125	2	9	4 1/4	3 1/4	Solid End.....	8	\$2 75
K-53001A	30	125	3	9	6 1/2	3 1/4	Solid End.....	10	4 00
K-53002A	30	125	2	9	4 1/4	3 1/4	Open (for meter trim).....	8	2 75
K-53003A	30	125	3	9	6 1/2	3 1/4	Open (for meter trim).....	10	4 00
K-53006	30	125	3	9	6 1/2	3 1/4	Solid end, solid neutral.....	10	4 00
K-53007	30	125	3	9	6 1/2	3 1/4	Open (for meter trim) solid neutral.....	10	4 00
K-53004A	30	250	2	9	4 1/4	3 1/4	Solid end.....	8	4 00
K-53005A	30	250	3	9	6 1/2	3 1/4	Solid end.....	10	5 00
K-53008	30	125	2	9	4 1/4	3 1/4	Open (for meter trim) 2 pole switch in 3 pole box.....	10	3 50
K-53050	30	125	2	9	4 1/4	3 1/4	Top end open—bottom end removable 2 pole switch in 3 pole box.....	10	3 75
K-53009	60	250	2	16	9	6 1/2	Removable end plate for meter trim.....	18	10 00
K-53010	60	250	3	16	11	6 1/2	Removable end plate, for meter trim.....	24	12 50
K-53011	100	250	2	18	13	8 3/4	Removable end plate, for meter trim.....	32	14 50
K-53012	100	125	3	18	16 1/2	8 3/4	Removable end plate, for meter trim.....	40	18 00

Meter Junction Box

K-57469	...	...	..	6 3/4	4 3/4	2	For use with Westinghouse type OA meter 0-80 amps.....	1 1/4	1 35
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Order by Style Number

TYPE WK-53 SAFETY SERVICE SWITCHES—Continued



30-AMPERE TYPE WK-53 SWITCH SHOWING DOUBLE BRANCH LOWER FUSE COMPARTMENT STYLE K-59301

30-AMPERE TYPE WK-53 SWITCH SHOWING SINGLE CIRCUIT TOP FUSE COMPARTMENT AND METER TRIM

Accessories for Type WK-53 Switches

Style No	Description	List Price Each
K-52033	Blank end with 3 standard combination knockouts $\frac{1}{2} \times \frac{1}{4}$ " to convert all open end switches to closed end switches.....	\$0 20
K-57058	Single circuit top fuse compartment.....	2 55
K-59301	Two circuit lower fuse compartment with door interlocked with switch door.....	3 40

Meter Trims for 30, 60 and 100-Ampere Type WK-53 Switches—2 or 3-Pole

The following Trims are interchangeable on all Type WK-53 Switches

(Not included in Style Number of Switch)

K-54558	Trim to fit Westinghouse 0-15-ampere type OA Watthour meter.....	40
K-54787	Trim to fit General Electric 5-25-ampere type I-14 Watthour meter.....	40
K-54786	Trim to fit Sangamo 5-15-ampere type H new model Watthour meter, also Duncan M-2 5-25-ampere 2 and 3 wire.....	40
K-54559	To fit 15-80 ampere Westinghouse type OA Watthour meter, used when meter is fitted with terminal cover and holding stud.....	40
K-56769	To fit 15-80 ampere Westinghouse type OA meter when meter is not fitted with terminal cover.....	40
K-56768	To fit 5-10 ampere Westinghouse type OA meter when meter is not fitted with terminal cover.....	40
K-59333	To fit 30-75 ampere General Electric type I-14 Watthour meter.....	90
K-59367	To fit 25-100 ampere Sangamo type H-2 meter.....	90

Order by Style Number

## ENCLOSED CARTRIDGE FUSES

**Non-Renewable Type with Indicators for Voltages up to 600**

**Renewable Type for Voltages up to 600**

### GENERAL

**Application**—These fuses meet the demand for reliable and accurate devices that will carry their rated current, and can be depended upon to open the circuit when the overloads are within the specified



FUSE STYLE NO. 37153 (NON-RENEWABLE)

limits. The circuit characteristics for the 250- and 600-volt fuses should be such as to limit the maximum overload current passing through the fuse to 10,000 amperes direct or alternating current, as specified in the "Underwriters' Laboratories Code for Electrical Appliances." Circuit-Breakers are recommended instead of enclosed fuses, where the power exceeds that specified above, as fuses are not suitable for such circuits (except where fuses are used for the protection of potential transformers.

See pages on limiting resistors for potential transformer fuses).

**Approval**—All of the fuses listed herein conform to the requirements of the Underwriters' Laboratories Code for Electrical Appliances for the sizes covered and are included in the "List of Approved Fittings" issued by the National Board of Fire Underwriters.

**Dimensions**—The 250-volt and 600-volt fuses have the "National Electrical Code Standard" dimensions and may be used in any "National Electrical Code Standard" fuse blocks of corresponding capacities.

**Finish**—The finish of the metal parts is cleaned brass on the ferrule type; cleaned and lacquered on the caps and cleaned copper on the blade of the knife-blade type.

**Mounting**—For fuse blocks on which these enclosed fuses may be mounted see pages of this catalogue on "Fuse Blocks for Enclosed Cartridge Fuses."

### NON-RENEWABLE CARTRIDGE FUSES, WITH INDICATORS

**Application** — Non-renewable cartridge fuses should be applied to circuits where the interruptions are very infrequent.

**Indicators**—Each fuse is provided with a simple but reliable device, which indicates whether the fuse has blown or is still intact. This indicator is in plain view, so that the condition of the fuse can be determined at a glance.

**Refilling**—The Westinghouse Electric & Manufacturing Company is prepared to refill any of its knife-blade-contact, non-renewable, enclosed fuses, provided the cases are returned to the works in good condition, transportation prepaid, in not less than standard package quantities. Complete return shipping instructions should accompany each order for fuses to be refilled. Refilling list prices are given

on the following pages, opposite the style numbers of the fuses which will be refilled.

The Company will refill fuses only when the cases are returned to the works, and under no circumstances will refilling material be furnished.



FUSE STYLE NO. 37203 (NON-RENEWABLE)

When cases are to be returned for refilling the nearest district office should be consulted for shipping directions.

### RENEWABLE CARTRIDGE FUSES

**Application**—Westinghouse Renewable Cartridge Fuses can be safely applied to all circuits heretofore protected by standard non-renewable enclosed cartridge fuses. Because of their inexpensive renewals, they are especially adaptable on circuits on which frequent interruptions occur.

The maximum interrupting capacity of Westinghouse Renewable Cartridge Fuses is equal to that of any and superior to that of many of the renewable or non-renewable cartridge fuses on the market. These fuses will operate under normal operating conditions many times without causing damage to

themselves. The highest accuracy of calibration obtainable for fuses is obtained in this type.

**Construction**—As a result of extensive research and development on renewable fuses, certain principles were found to be absolutely necessary to secure maximum successful operation and safety in service. By new and novel means these principles were embodied in the Westinghouse design, thus advancing the art of renewable-fuse protection.

A distinctive feature in this design is the method of venting and cooling of the hot gases generated when the fuse volatilizes. Permanently held in the

ENCLOSED CARTRIDGE FUSES—Continued

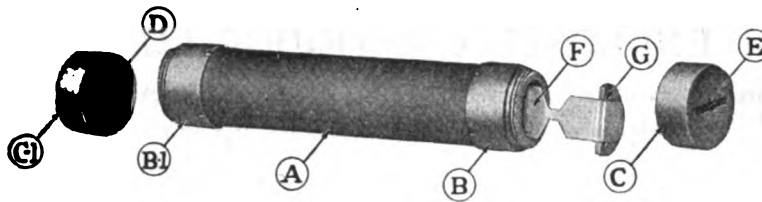


FIG. 1. FERRULE-TYPE WESTINGHOUSE RENEWABLE FUSE

- A.—Special Hard Bone Fibre Tube.
- B. and B-1. Brass Ferrules rigidly fastened to the tube and which cannot be turned off, when refilling the fuse.
- C. and C-1. Removable caps, constructed so as to vent and cool the hot gases sufficiently to prevent flashes and excessive pressure.
- D.—Holes through which the hot gases enter the venting system.
- E.—Hole through which the gases escape from the fuse at a safe temperature.
- F.—Drop-out type of link.
- G.—Loose washer properly located by projections.

ferrule type are two washers; a metal washer separated from the end of the cap by a fullerboard washer. The metal disc is perforated with several small holes through which the hot gases pass. These gases then flow out over the edge of the fullerboard disc and are carried through a series of radial grooves in the end of the cap to a centrally-located hole and thus to the outside.

The knife-blade type is provided with a series of two or three fixed and one removable-end washer, having the central portions of adjacent surfaces recessed to form chambers between washers. These chambers are connected to each other and to the inside of the fuse tube and to the outside by a series of small openings, spaced 180 degrees on the same washer and about 90degrees on the adjacent washers.

While providing a ready path for the escape of gases from the fuse tube, these systems of venting retard the flow sufficiently to insure enough gas pressure within the cartridge to extinguish the arc effectively, but not to damage the casing. The heated gases are cooled sufficiently in their passage through the venting system, so that they leave the fuses at a safe temperature, that eliminates all hazard of fire or personal injury.

Other advantages of this system are that there is

no burning of the threads on the fibre cases as no gases pass along these threads. There are no leather or cotton washers to burn. The end washers will not be bulged on the most severe short circuits. There will be no collection of fuse elements on the surfaces that cannot be removed without tools.

The general construction of Westinghouse Renewable Fuses has been given very careful attention. Strongly made casings of the best bone-fibre tubing insure long life. Drop-out links manufactured under United States Letters Patent number 1217289 and re-issue number 14183 are used. In the knife-blade type the links are solidly bolted to the copper terminals. This construction insures a contact superior to any obtainable where the use of tools is entirely avoided. Rigid and accurate relationship of blades, caps and casings gives a very solid structure.

**Renewing**—Westinghouse Renewable Fuses combine maximum simplicity in the renewal of links with a minimum number of loose parts. In the renewal of links, it is impossible to omit any part and, therefore, impossible to decrease the safety of either the ferrule or knife-blade type.

In renewing the ferrule type fuse no tools are required. The only parts to be detached are a cap and one washer from either end.

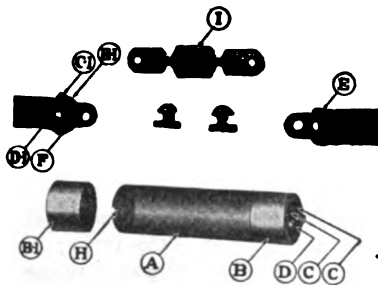


FIG. 2

- A—Special hard bone fibre tube.
- B and B-1—Removable caps.
- C and C-1—Removable washers.
- D and D-1—Screws attached to removable washers and used to fasten washers to fixed washers.
- E and E-1—Fixed washers constructed so as to vent and cool the hot gases sufficiently to prevent flashing and excessive pressure.
- F—Opening through which hot gases enter the venting system.
- G—Holes through which gases escape from the fuse at a safe temperature.
- H—Centering means.
- I—Drop-out type of link.

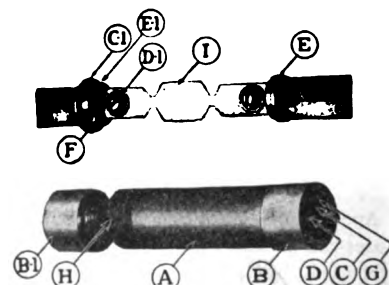


FIG. 3

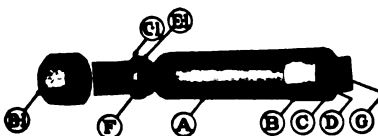


FIG. 4

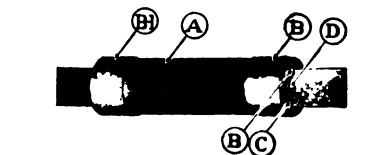


FIG. 5

KNIFE-BLADE TYPE WESTINGHOUSE RENEWABLE FUSE



ENCLOSED CARTRIDGE FUSES—Continued

To renew the knife-blade fuse, it is necessary to remove one cap only. Then only such tools have to be used as are required for loosening two screws on the opposite end and for bolting the links to the contacts.

Style number and list price of the renewable fuse include the fuse with one renewal link, mounted in position for operation in the fuse. Style number and list price for the renewal link include one renewal link only.

FOR VOLTAGES UP TO 250

Ampere Carrying Capacity	Standard Package Quantity	Carton Quantity	NON-RENEWABLE FUSE			RENEWABLE FUSE COMPLETE			RENEWAL LINKS ONLY†		
			Approx. Net Wt. of Carton, Lb.	Style No.	List Price Each	Refilling List Price Each	Approx. Net Wt. of Carton, Lb.	Style No.	List Price Each	Approx. Net Wt. of Std. Pk. Oz.	Style No.
<b>Ferrule Contacts</b>											
1	100	20	1	37153	\$0 20	...	...	...	..	...	...
2	100	20	1	37154	20	...	...	...	..	...	...
3	100	20	1	37155	20	2	292807	\$0 50	3	292824	\$0 03
4	100	20	1	37156	20	2	292808	50	3	292825	03
5	100	20	1	37157	20	2	292809	50	3	292826	03
6	100	20	1	37158	20	2	292810	50	3	292827	03
8	100	20	1	37159	20	2	292811	50	3	292828	03
10	100	20	1	37160	20	2	292812	50	3	292829	03
12	100	20	1	37161	20	2	292813	50	3	292830	03
15	100	20	1	37162	20	2	292814	50	3	292831	03
20	100	20	1	37163	20	2	292815	50	3	292832	03
25	100	20	1	37164	20	2	292816	50	3	292833	03
30	100	20	1	37165	20	2	292817	50	3	292834	03
35	100	20	2	37166	30	3 3/4	292818	1 00	10	292835	05
40	100	20	2	37167	30	3 3/4	292819	1 00	10	292836	05
45	100	20	2	37168	30	3 3/4	292820	1 00	10	292837	05
50	100	20	2	37169	30	3 3/4	292821	1 00	10	292838	05
55	100	20	2	184110	30	3 3/4	292822	1 00	10	292839	05
60	100	20	2	37170	30	3 3/4	292823	1 00	10	292840	05
<b>Knife-Blade Contacts</b>											
65	50	10	3	184111	90 \$ 60	3 3/4	292841	2 00	6	292867	10
70	50	10	3	184112	90 60	3 3/4	292842	2 00	6	292868	10
75	50	10	3	37171	90 60	3 3/4	292843	2 00	6	292869	10
80	50	10	3	184113	90 60	3 3/4	292844	2 00	6	292870	10
85	50	10	3	37172	90 60	3 3/4	292845	2 00	6	292871	10
90	50	10	3	184114	90 60	3 3/4	292846	2 00	6	292872	10
95	50	10	3	184115	90 60	3 3/4	292847	2 00	6	292873	10
100	50	10	3	37173	90 60	3 3/4	292848	2 00	6	292874	10
110	25	5	4 1/4	184116	2 00 90	4	292849	4 00	7	292875	15
120	25	5	4 1/2	184117	2 00 90	4	292850	4 00	7	292876	15
125	25	5	4 3/4	37174	2 00 90	4	292851	4 00	7	292877	15
150	25	5	4 1/4	37175	2 00 90	4	292852	4 00	7	292878	15
175	25	5	4 1/2	37176	2 00 90	4	292853	4 00	7	292879	15
200	25	5	4 3/4	37177	2 00 90	4	292854	4 00	7	292880	15
225	25	1	1 1/4	37178	3 60 1 50	1 1/2	292855	7 50	14	292881	30
250	25	1	1 3/4	37179	3 60 1 50	1 1/2	292856	7 50	14	292882	30
275	25	1	1 3/4	184118	3 60 1 50	1 1/2	292857	7 50	14	292883	30
300	25	1	1 3/4	37180	3 60 1 50	1 1/2	292858	7 50	14	292884	30
325	25	1	1 3/4	184119	3 60 1 50	1 1/2	292859	7 50	14	292885	30
350	25	1	1 3/4	37181	3 60 1 50	1 1/2	292860	7 50	14	292886	30
375	25	1	1 3/4	184120	3 60 1 50	1 1/2	292861	7 50	14	292887	30
400	25	1	1 3/4	37182	3 60 1 50	1 1/2	292862	7 50	14	292888	30
450	10	1	3 1/4	184121	5 50 2 00	2 1/4	292863	11 00	11	292889	60
500	10	1	3 1/2	37183	5 50 2 00	2 1/4	292864	11 00	11	292890	60
550	10	1	3 3/4	184122	5 50 2 00	2 1/4	292865	11 00	11	292891	60
600	10	1	3 3/4	37184	5 50 2 00	2 1/4	292866	11 00	11	292892	60

FOR VOLTAGES UP TO 600

<b>Ferrule Contacts</b>												
Ampere Carrying Capacity	Standard Package Quantity	Carton Quantity	Approx. Net Wt. of Carton, Lb.	Style No.	List Price Each	Refilling List Price Each	Approx. Net Wt. of Carton, Lb.	Style No.	List Price Each	Approx. Net Wt. of Std. Pk. Oz.	Style No.	List Price Each
1	100	20	3	37185	\$0 40	...	...	...	..	...	...	
2	100	20	3	37186	40	...	...	...	..	...	...	
3	100	20	3	37187	40	4 1/4	292893	\$1 10	9	292910	\$0 05	
4	100	20	3	37188	40	4 1/2	292894	1 10	9	292911	05	
5	100	20	3	37189	40	4 1/2	292895	1 10	9	292912	05	
6	100	20	3	37190	40	4 1/2	292896	1 10	9	292913	05	
7	100	20	3	184123	40	...	...	...	..	...	...	
8	100	20	3	37191	40	4 1/2	292897	1 10	9	292914	05	
9	100	20	3	184124	40	...	...	...	..	...	...	
10	100	20	3	37192	40	4 1/2	292898	1 10	9	292915	05	
12	100	20	3	37193	40	4 1/2	292899	1 10	9	292916	05	
15	100	20	3	37194	40	4 1/2	292900	1 10	9	292917	05	
20	100	20	3	37195	40	4 1/2	292901	1 10	9	292918	05	
25	100	20	3	37196	40	4 1/2	292902	1 10	9	292919	05	
30	100	20	3	37197	40	4 1/2	292903	1 10	9	292920	05	
35	100	10	2 1/4	37198	60	3 3/4	292904	1 25	9	292921	06	
40	100	10	2 1/4	37199	60	3 3/4	292905	1 25	9	292922	06	
45	100	10	2 1/4	37200	60	3 3/4	292906	1 25	9	292923	06	
50	100	10	2 1/4	37201	60	3 3/4	292907	1 25	9	292924	06	
55	100	10	2 1/4	184125	60	3 3/4	292908	1 25	9	292925	06	
60	100	10	2 1/4	37202	60	3 3/4	292909	1 25	9	292926	06	

\*For shipping weight add 10 per cent for boxing. †Links are packed in standard package quantities only.

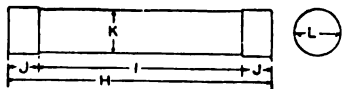
ENCLOSED CARTRIDGE FUSES—Continued

FOR VOLTAGES UP TO 600—Continued

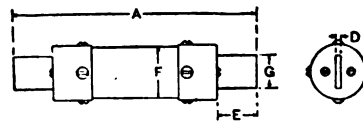
Ampere Carrying Capacity	Standard Package Quantity	Carton Quantity	NON-RENEWABLE FUSE			RENEWABLE FUSE COMPLETE			RENEWABLE LINK ONLY†			
			Approx. Net* Wt. of Carton, Lb.	Style No.	List Price Each	Refilling List Price Each	Approx. Net* Wt. of Carton, Lb.	Style No.	List Price Each	Approx. Net* Wt. of Std. Pck. Oz.	Style No.	List Price Each
<b>Knife-Blade Contacts</b>												
65	50	5	2 1/4	184126	\$1 50	\$ 80	3 1/4	292927	\$3 00	10	292953	\$0 10
70	50	5	2 1/4	184127	1 50	80	3 1/4	292928	3 00	10	292954	10
75	50	5	2 1/4	37203	1 50	80	3 1/4	292929	3 00	10	292955	10
80	50	5	2 1/4	184128	1 50	80	3 1/4	292930	3 00	10	292956	10
85	50	5	2 1/4	37204	1 50	80	3 1/4	292931	3 00	10	292957	10
90	50	5	2 1/4	184129	1 50	80	3 1/4	292932	3 00	10	292958	10
95	50	5	2 1/4	184130	1 50	80	3 1/4	292933	3 00	10	292959	10
100	50	5	2 1/4	37205	1 50	80	3 1/4	292934	3 00	10	292960	10
110	25	5	7 1/4	184131	2 50	1 20	6 1/4	292935	5 00	12	292961	15
120	25	5	7 1/4	184132	2 50	1 20	6 1/4	292936	5 00	12	292962	15
125	25	5	7 1/4	37206	2 50	1 20	6 1/4	292937	5 00	12	292963	15
150	25	5	7 1/4	37207	2 50	1 20	6 1/4	292938	5 00	12	292964	15
175	25	5	7 1/4	37209	2 50	1 20	6 1/4	292939	5 00	12	292965	15
200	25	5	7 1/4	37209	2 50	1 20	6 1/4	292940	5 00	12	292966	15
225	25	1	3 3/4	37210	5 50	2 00	2 3/4	292941	11 00	24	292967	30
250	25	1	3 3/4	37211	5 50	2 00	2 3/4	292942	11 00	24	292968	30
275	25	1	3 3/4	184133	5 50	2 00	2 3/4	292943	11 00	24	292969	30
300	25	1	3 3/4	37212	5 50	2 00	2 3/4	292944	11 00	24	292970	30
325	25	1	3 3/4	184134	5 50	2 00	2 3/4	292945	11 00	24	292971	30
350	25	1	3 3/4	37213	5 50	2 00	2 3/4	292946	11 00	24	292972	30
375	25	1	3 3/4	184135	5 50	2 00	2 3/4	292947	11 00	24	292973	30
400	25	1	3 3/4	37214	5 50	2 00	2 3/4	292948	11 00	24	292974	30
450	10	1	5 1/4	184136	8 00	3 00	4	292949	16 00	20	292975	60
500	10	1	5 1/4	37215	8 00	3 00	4	292950	16 00	20	292976	60
550	10	1	5 1/4	184137	8 00	3 00	4	292951	16 00	20	292977	60
600	10	1	5 1/4	37216	8 00	3 00	4	292952	16 00	20	292978	60

\*For shipping weight add 10 per cent for boxing. †Links are packed in standard package quantities only.

OUTLINE DIMENSIONS



FERRULE CONTACTS 1 TO 60 AMPS.



KNIFE-BLADE CONTACTS 61 TO 600 AMPS.

FIG. 10

Ampere Carrying Capacity	Fig.	DIMENSIONS IN INCHES									
		A	D	E	F	G	H	I	J	K	L

FOR VOLTAGES UP TO 250

1-30	10	...	...	...	...	...	2	1	1/2	1/2	1/2
35-60	10	...	...	...	...	...	3	1 1/4	1/2	1/2	1/2
65-100	10	5 1/2	1/2	1	1	1 1/2	...	...	...	...	...
110-200	10	7 1/2	1/2	1 1/4	1 1/2	1 1/2	...	...	...	...	...
225-400	10	8 3/4	1/2	1 3/4	2	1 3/4	...	...	...	...	...
450-600	10	10 3/4	1/2	2 1/4	2 1/2	2	...	...	...	...	...

FOR VOLTAGES UP TO 600

1-30	10	...	...	...	...	...	5	4	1/2	1/2	1/2
35-60	10	...	...	...	...	...	5 1/2	4 1/4	1/2	1 1/4	1 1/4
65-100	10	7 1/2	1/2	1	1 1/2	1 1/2	...	...	...	...	...
110-200	10	9 3/4	1/2	1 1/2	1 3/4	1 3/4	...	...	...	...	...
225-400	10	11 3/4	1/2	1 3/4	2 1/2	1 3/4	...	...	...	...	...
450-600	10	13 3/4	1/2	2 1/4	3	2	...	...	...	...	...

## KNIFE SWITCHES

Westinghouse Knife Switches are simple in design, substantial in construction and neat in appearance.

The current-carrying parts consist of a high grade drawn copper of guaranteed conductivity. The sectional areas and contact faces on all sliding and stationary parts have been calculated in accordance with the best practice and a liberal allowance has been made for overloads.

Two types of knife switches are listed: Types A and C.

**Approval**—All of the switches listed conform to the requirements of the "National Electrical Code" and are included in the "List of Approved Fittings" issued by the NATIONAL BOARD OF FIRE UNDERWRITERS. When operating under normal conditions and within their rated capacities, the temperature rise of these switches is well within the limits specified by the Underwriters.

**Temperature**—The current-carrying parts adjacent to the contacts will carry their full rated current continuously with a maximum temperature rise of either 20 or 30 degrees Centigrade above the temperature of the surrounding atmosphere, depending upon the class of service mentioned below into which the switches are placed.

It is necessary that adjacent apparatus does not heat the switch; that conductors to the switch are ample to carry the current with a temperature rise not exceeding that of the switch; that reasonable ventilation is provided; that connections are clean and tight; and that the break jaw blades make good contact with the switch blade.

The 20-degree rise basis is recommended when the maximum temperature of the air, where the switch is located, may be approximately 40 degrees Centigrade and the load practically continuous as on the generator, rotary or transformer systems.

The 30-degree rise basis is recommended where the maximum temperature of the air, where the switch is located, may approximate 30 degrees Centigrade or less, and the load is intermittent, as on feeder circuits.

Switches of 1000-ampere capacity and below have the same ratings for either alternating current or direct current on either the 20 or 30-degree rise basis.

Switches of 1200-ampere capacity D.C. and larger are given the following lower ratings for alternating current, and are not guaranteed to carry more than their rated current.

D.C.	20° RISE		D.C.	30° RISE	
	25-Cy.	60-Cy.		25-Cy.	60-Cy.
1200	1100	1100	1000	1000	1000
1600	1400	1200	1300	1200	1100
2000	1800	1600	1600	1400	1200
3000	2500	2200	2400	2000	1800
4000	3400	2800	3200	2700	2200
6000	4200	3800	4500	3200	2800

**Momentary Current**—The maximum momentary current passing through knife switches should not be greater, owing to mechanical and electrical limitations, than 50 times their normal 60-cycle 20-degree ampere rating for one second. If the switches will be subjected to greater current momentarily than this, a switch of larger normal rating (amperes) should be used, as they are both mechanically and electrically stronger.

**Finish**—Types A and C front-connected switches have plain finish. They can also be furnished with satin finish or polished finish at an increase in price.

Type A rear-connected switches have satin finish. They can also be furnished with plain finish at a reduction in price, or with polished finish at an increase in price.

**Handles**—Spade handles are regularly furnished on all four-pole switches and on all three-pole switches above 600-ampere capacity. All other switches have straight handles. Switches shipped with straight handles do not have the cross bar drilled for the mounting screws of the spade handles. If spade handles are later supplied, arrangements should be made for drilling the cross bars to accommodate the spade handles.

**Quick-Break Attachments**—Types A and C switches can be supplied without or with quick-break attachments, except for 30 amps. 250 volts. Switches with quick-break attachments are recommended for use on circuits protected by fuses only, and on circuits where current has to be broken. For circuits protected by circuit-breakers, quick-break attachments are not necessary as the breaker should always be used when disconnecting the circuit.

**Fuses**—Fused switches are arranged for National Electrical Code Standard Enclosed Fuses. The 800, 1000 and 1200-ampere fused switches are arranged for two fuses in parallel.

**High Jaws**—All switches that are fused on the hinge jaws have high jaws to allow the switch handle and blades, when in the open position, to lie flat over the fuses. All switches that are fused on the break jaws have high break jaws to allow clearance between the switch handle and the fuses.

**Bases**—Types A and C front-connected switches are furnished mounted on high-grade slate bases with oil finish. They can also be furnished without bases at a reduction in price.

Type A rear-connected switches are furnished without bases. They can also be furnished with wood templates or slate or marble bases at an increase in price.

### Type A Switches

**Construction**—Type A switches have milled jaws and are of the highest grade of construction.

**Front-Connected**—Type A front-connected switches are listed up to 1200 amperes for maximum

## KNIFE SWITCHES—Continued

voltages of 250 D.C. or A.C. or 500 A.C.; and up to 600 amperes for maximum voltage of 600 D.C. or A.C.; fused or not fused; without quick-break attachments at 250 and 500 volts and with or without quick-break attachments at 600 volts; single or double-throw.

**Rear-Connected with Round Studs**—Type A rear-connected switches with round studs are listed in capacities up to 2000 amperes not fused or 1200 amperes fused; for maximum voltages of 250 D.C. or A.C. or 500 A.C. and up to 2000 amperes not fused or 600 amperes fused for maximum voltage of 600 D.C. or A.C., with or without quick-break attachments; single or double-throw.

**Rear-Connected with Laminated Studs**—Type A rear-connected switches with laminated studs are furnished with the conductor slots in the studs horizontal. They are listed in capacities from 1600 amperes to 6000 amperes, not fused; for maximum voltages of 250 D.C. or 500 A.C. and 600 D.C. or A.C.; without quick-break attachments; single or double-throw.

Style numbers listed are for switches with horizontally-laminated studs. Switches with vertically-laminated studs can be supplied on order, and prices can be supplied on request.

### Type C Switches

**Construction**—Type C switches have punched jaws. This is the chief difference in the construction between the types C and A switches and it results in a lower cost for the type C switch.

**Front-Connected**—Type C switches are supplied in front-connection only. They are listed up to 200 amperes, fused or not fused; for maximum voltages of 250 D.C. or A.C., 500 A.C. and 600 D.C. or A.C., without quick-break attachments; at 250 and 500 volts and with or without quick-break attachments at 600 volts; single or double-throw.

### Instructions for Ordering

**Style number and list price** of types A and C front-connected switches include switch with plain finish, complete with terminals and slate base with oil finish, but without fuses.

**Style number and list price** of type A rear-connected switches with round studs include switch with satin finish without base or fuses; complete with sufficient nuts on each stud to clamp the switch and to make connections to carry the rated current; with terminals on one stud per pole on single-throw and on two studs per pole on double-throw switches rated 800 amperes and below, and without terminals on switches rated above 800 amperes. If terminals are specified at time of entry of order, one stud per pole on single-throw and two studs per pole on double-throw switches, rated 1000 and 1200 amperes, will be supplied with terminals at the regular list price.

These switches can be supplied equipped with Westinghouse-Frankel Solderless Connectors if de-

sired. For prices see pages on Westinghouse-Frankel Solderless Connectors.

**Style number and list price** of type A rear-connected switches with laminated studs include switch with satin finish without base or terminals.

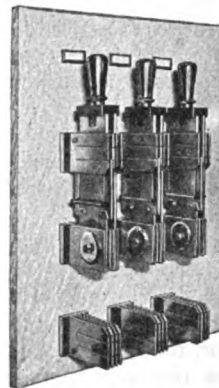
When fuses are required with switches, they should be ordered as separate items—see pages listing “fuses.”

When top-fused, single-throw switches are required they should be ordered by referring to the style number of the bottom-fused single-throw switch and stating: “Same as style number . . . except fused at top.”

When terminals, other than those included in the style number are required, they should be ordered as separate items—see pages listing “Terminals” under “Switchboard Details.”

When extra nuts are required they should be ordered as separate items—see pages on “Nuts” under “Switchboard Details.”

When spade handles are required with switches other than four-pole or three-pole above 600 ampere capacity, the switches should be ordered by referring to the style number and stating: “Same as style number . . . . . except to have spade handle.”



THREE TYPE A KNIFE SWITCHES, REAR CONNECTED—SINGLE-POLE, DOUBLE-THROW, 3000 AMPERES, 600 VOLTS, WITH QUICK-BREAK ATTACHMENTS.

When switches are required with quick-break attachments and are not so listed, they should be ordered by referring to the style number of the switch without quick-break attachments and stating “Same as style number . . . . . except to have quick-break attachments.”


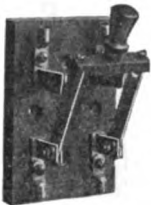
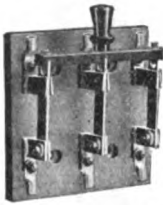
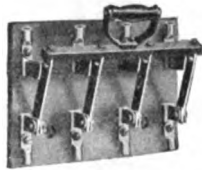




When rear-connected switches with bases are required, they should be ordered by referring to the style number and stating: “Same as style number . . . . . except mounted on . . . . . (giving the kind of base.)” Wood templates, slate or black marine marble bases of standard sizes, as shown in the tables of dimensions, can be supplied at the increase in price as shown in the price tables. If other than standard size bases are required or if marble bases with special finishes are required, they will be supplied at special prices.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

250 VOLTS D-C. AND 500 VOLTS A-C.

Single-Throw—Not Fused												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
												
227876	\$ 80	2	227886	\$ 1 20	2 1/4	*30	227898	\$ 1 80	3	227911	\$ 2 40	4
257199	1 14	2	257200	1 64	3 1/4	130	227899	2 48	4 1/2	227912	3 30	8
227877	1 20	2	227887	1 78	3 1/4	60	227900	2 68	4 1/2	227913	3 56	8
227878	2 25	2 3/4	227888	3 38	5 3/4	100	227901	5 08	8 1/2	227914	6 76	12 1/2
227879	3 48	4 1/2	227889	5 20	10 1/2	200	227902	7 80	15 1/2	227915	10 40	20
227881	8 14	10	227891	12 20	19	400	227904	18 30	30	227917	25 94	34
227882	11 54	15	227892	17 30	24	600	227905	25 98	35	227918	36 78	48
227883	20 00	24	227893	30 00	41	800	227906	45 00	58	227919	60 00	76
227884	23 68	26	227894	34 00	45	1000	227907	51 00	65	227920	68 00	84
227885	27 34	29	227895	41 00	50	1200	227908	61 50	75	227921	82 00	96
Double-Throw—Not Fused												
												
227924	1 18	2 1/4	227934	1 76	5	*30	227946	2 64	4	227959	3 52	6
257201	1 58	2 1/4	257202	2 26	6	130	227947	3 40	8	227960	4 60	13
227925	1 74	2 3/4	227935	2 60	6	60	227948	3 90	8	227961	5 20	13
227926	3 34	3 3/4	227936	5 00	9 1/2	100	227949	7 50	13	227962	10 00	19
227927	5 34	6	227937	8 00	16 1/2	200	227950	12 00	23	227963	16 00	30
227929	12 54	13	227939	18 80	26	400	227952	28 20	46	227965	37 60	54
227930	17 34	22	227940	26 00	35	600	227953	39 00	54	227966	52 00	74
227931	28 00	36	227941	42 00	65	800	227954	63 00	94	227967	84 00	115
227932	31 68	39	227942	47 50	72	1000	227955	71 25	105	227968	95 00	128
227033	40 00	44	227943	60 00	78	1200	227956	90 00	125	227969	120 00	150

Plain Finish included in style number and price.

Satin Finish, 30 to 200 amperes inclusive add 30 per cent; above 200 amperes add 20 per cent.

Polished Finish, add 10 per cent to price of satin finish.

Slate Bases included in style number and price.

Unmounted Switches, deduct 10 per cent.

Terminals included in style number and price.

Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Quick-Break Attachments, see page 1043 for additional price.

Shipping Weights, see page 1044.

\*For 250 volts D.C. only.

†For 500 volts A.C.

†All ratings below the 1200 ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. The 1200 ampere rating is D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

250 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
227972	\$ 1 18	2	227981	\$ 1 76	2½	30	227990	\$ 2 64	4	227999	\$ 3 52	6½
227973	1 74	3¼	227982	2 60	4½	60	227991	3 90	6½	228000	5 20	10
227974	3 34	5½	227983	5 00	9	100	227992	7 50	14	228001	10 00	21
227975	5 14	9	227984	7 70	17	200	227993	11 56	24	228002	15 40	37
227976	11 64	16	227985	17 46	29	400	227994	26 20	48	228003	37 10	67
227977	16 34	22	227986	24 50	44	600	227995	36 75	60	228004	52 06	88
227978	26 34	36	227987	39 50	65	800	227996	59 25	100	228005	79 00	130
227979	30 34	40	227988	45 50	72	1000	227997	68 25	110	228006	91 00	144
227980	35 68	45	227989	53 50	80	1200	227998	80 25	122	228007	107 00	160
Double-Throw — Fused At Both Ends												
228044	2 28	3	228053	3 40	5	30	228062	5 10	7	228071	6 80	12
228045	3 08	6	228054	4 60	8	60	228063	6 90	13	228072	9 20	19
228046	6 20	9½	228055	9 30	15	100	228064	13 96	26	228073	18 60	40
228047	9 34	15	228056	14 00	25	200	228065	21 00	46	228074	28 00	67
228048	18 68	29	228057	28 00	49	400	228066	42 00	88	228075	56 00	117
228049	27 68	35	228058	41 50	74	600	228067	62 25	117	228076	83 00	166
228050	42 68	60	228059	64 00	105	800	228068	96 00	145	228077	128 00	200
228051	50 68	72	228060	76 00	130	1000	228069	114 00	160	228078	152 00	216
228052	58 68	80	228061	88 00	150	1200	228070	132 00	175	228079	176 00	240

Plain Finish included in style number and price.

Satin Finish, 30 to 200 amperes inclusive add 30 per cent; above 200 amperes add 20 per cent.

Polished Finish, add 10 per cent to price of satin finish.

Slate Bases included in style number and price.

Unmounted Switches, deduct 10 per cent.

Terminals included in style number and price.

Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included in all other switches. For price of spade handles refer to page 1044.

Quick-Break Attachments, see page 1043 for additional price.

Single-Throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping weights, see page 1044.









†All ratings below the 1200 ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. The 1200 ampere rating is D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

500 VOLTS A-C.

Single-Throw — Fused At Bottom												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
255252	\$ 1 75	2	255253	\$ 2 65	3	30	228080	\$ 4 00	7 1/2	228089	\$ 5 34	12
255258	2 05	3 1/4	255259	3 05	4 1/4	60	228081	4 60	8 3/4	228090	6 14	19
255264	3 60	6 1/2	255265	5 45	10	100	228082	8 20	17	228091	10 94	27
255270	5 80	10	255271	8 70	19	200	228083	13 10	25	228092	17 48	42
255276	12 65	18	255277	19 00	33	400	228084	28 50	50	228093	36 00	72
255282	17 75	25	255283	28 65	47	600	228085	40 00	65	228094	53 34	91
262040	27 50	38	262041	41 30	72	800	228086	62 00	108	228095	82 68	140
262052	31 05	45	262053	48 60	85	1000	228087	70 00	120	228096	93 34	155
262064	37 25	49	262065	55 95	90	1100	228088	84 00	130	228097	112 00	170
Double-Throw — Fused At Both Ends												
												
255256	3 35	3 1/4	255257	5 00	5	30	228116	7 50	10	228125	10 00	23
255262	4 00	6 1/4	255263	6 00	9	60	228117	9 00	15	228126	12 00	35
255268	7 10	11	255269	10 65	17	100	228118	16 00	27	228127	21 32	60
255274	10 40	17	255275	15 65	27	200	228119	23 50	49	228128	31 32	74
255280	21 30	29	255281	31 95	51	400	228120	48 00	83	228129	60 00	127
255286	31 95	37	255287	47 95	77	600	228121	72 00	127	228130	96 00	146
262048	48 80	46	262049	73 25	90	800	228122	110 00	160	228131	146 66	210
262060	53 20	55	262061	79 90	110	1000	228123	120 00	176	228132	180 00	240
262072	62 10	62	262073	93 25	122	1100	228124	140 00	192	228133	186 66	270


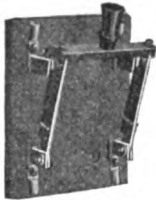
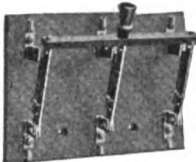



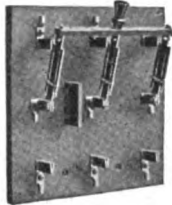
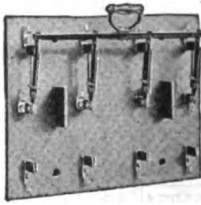
Plain Finish included in style number and price.  
 Satin Finish, 30 to 200 amperes inclusive add 30 per cent; above 200 amperes, add 20 per cent.  
 Polished Finish, add 10 per cent to price of satin finish.  
 Slate Bases included in style number and price.  
 Unmounted Switches, deduct 10 per cent.  
 Terminals included in style number and price.  
 Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Quick-Break Attachments, see page 1043 for additional price.  
 Single-Throw Switches Fused at Top can be furnished on special request.  
 Fuses not included in style number and price. See pages 1017 and 1018.  
 Shipping Weights, see page 1044.  
 †All ratings below 1100 ampere are A.C. on either the 20- or 30-degree rise basis. The 1100 ampere rating is A.C. on the 30-degree rise basis. For reduced ratings on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Front-Connected—With or Without Quick-Break Attachments—Plain Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Not Fused												
With Quick-Break Attachments												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
228134	\$ 1 50	2¼	228144	\$ 2 72	5¼	30	228154	\$ 4 38	7	228164	\$ 6 02	10
228135	1 90	2½	228145	2 90	5¾	60	228155	4 64	8	228165	6 38	11
228136	2 76	3½	228146	5 00	9	100	228156	8 00	14½	228166	11 00	20
228137	4 40	6	228147	8 00	14¼	200	228157	12 80	25	228167	17 60	33
228139	9 38	10	228149	17 00	26	400	228159	27 20	45	228169	37 40	60
228140	12 38	14	228150	22 50	32	600	228160	38 00	54	228170	49 50	72
Without Quick-Break Attachments												
228141	1 18	2¼	228151	2 12	5¼	30	228161	3 40	7	228171	4 70	10
228142	1 28	2½	228152	2 30	5¾	60	228162	3 68	8	228172	5 06	11
228143	2 35	3½	228153	4 00	9	100	228163	6 40	14½	228173	8 80	20
Double-Throw — Not Fused												
With Quick-Break Attachments												
												
228174	2 64	2¾	228184	4 76	10	30	228194	7 64	15	228204	10 52	20
228175	2 76	3	228185	5 00	11	60	228195	8 00	16¼	228205	11 00	21½
228176	4 08	5	228186	7 40	15	100	228196	11 84	24	228206	16 28	32
228177	6 60	9	228187	12 00	22	200	228197	19 20	38	228207	26 40	51
228179	13 76	17	228189	25 00	38	400	228199	40 00	68	228209	55 00	90
228180	17 60	22	228190	32 00	50	600	228200	51 20	80	228210	70 40	110
Without Quick-Break Attachments												
228181	2 36	2¾	228191	4 26	10	30	228201	6 84	15	228211	9 42	20
228182	2 48	3	228192	4 50	11	60	228202	7 20	16¼	228212	9 90	21½
228183	3 58	5	228193	6 50	15	100	228203	10 40	24	228213	14 30	32

Plain Finish included in style number and price.

Satin Finish, 30 to 200 amperes inclusive add 30 per cent; above 200 amperes add 20 per cent.

Polished Finish, add 10 per cent to price of satin finish.

Slate Bases included in style number and price.

Unmounted Switches, deduct 10 per cent.

Terminals included in style number and price.

Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Quick-Break Attachments, see page 1043 for additional price.

Shipping Weights, see page 1044.









†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis



KNIFE SWITCHES—Continued

TYPE A SWITCHES

Front-Connected—With or Without Quick-Break Attachments—Plain Finish  
600 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Quick-Break Attachments												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
228214	\$2 18	3 1/2	228223	\$ 3 92	8 1/4	30	228232	\$ 6 30	22	228241	\$ 8 66	32 1/2
228215	2 34	4 1/2	228224	4 26	9 1/2	60	228233	6 82	23	228242	9 38	34
228216	3 90	8 1/2	228225	7 10	19	100	228234	11 36	45	228243	15 62	67
228217	6 16	17	228226	11 20	32	200	228235	17 92	69 1/2	228244	24 64	104
228218	12 94	28	228227	23 50	49	400	228236	37 60	105	228245	51 70	156
228219	17 34	36	228228	31 50	62	600	228237	50 40	130	228246	69 30	196
Without Quick-Break Attachments												
228220	1 84	3 1/4	228229	3 32	8 1/4	30	228238	5 34	22	228247	7 34	32 1/2
228221	2 04	4 1/2	228230	3 70	9 1/2	60	228239	5 92	23	228248	8 14	34
228222	3 48	8 1/2	228231	6 30	19	100	228240	10 08	45	228249	13 86	67
Double-Throw — Fused At Both Ends												
With Quick-Break Attachments												
												
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Amps. †	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
228286	3 74	9 1/2	228295	6 74	15	30	228304	10 84	26	228313	14 92	35
228287	4 08	10	228296	7 40	16	60	228305	11 84	27	228314	16 28	38
228288	6 88	15	228297	12 50	30	100	228306	20 00	52	228315	27 50	70
228289	10 46	28	228298	19 00	50	200	228307	30 40	76	228316	41 80	102
228290	19 80	42	228299	38 00	74	400	228308	57 60	100	228317	79 20	135
228291	29 70	53	228300	54 00	90	600	228309	86 40	130	228318	118 80	175
Without Quick-Break Attachments												
228292	3 12	9 1/2	228301	5 42	15	30	228310	9 40	26	228319	12 50	35
228293	3 58	10	228302	6 00	16	60	228311	10 40	27	228320	13 50	38
228294	6 34	15	228303	11 50	30	100	228312	18 40	52	228321	25 30	70

Plain Finish included in style number and price.  
 Satin Finish, 30 to 200 amperes inclusive add 30 per cent; above 200 amperes add 20 per cent.  
 Polished Finish, add 10 per cent to price of satin finish.  
 Slate Bases included in style number and price.  
 Unmounted Switches, deduct 10 per cent.  
 Terminals included in style number and price.  
 Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Quick-Break Attachments, see page 1043 for additional price.  
 Single-Throw Switches Fused at Top can be furnished on special request.  
 Fuses not included in style number and price. See pages 1017 and 1018.  
 Shipping Weights, see page 1044.  
 †All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

250 VOLTS D-C. AND 500 VOLTS A-C.

Single-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
189800	\$ 96	1	189801	\$ 1 74	1½	*30	189802	\$ 2 60	2¼	189803	\$ 3 48	2¾
280910	1 44	1	280911	2 58	1½	130	280912	3 90	2¼	280913	5 20	2¾
189808	1 50	1	189809	2 70	1½	60	189810	4 06	2¼	189811	5 40	2¾
189824	2 54	1¼	189825	4 60	3	100	189826	6 90	4¼	189827	9 20	6
189840	3 90	2½	189841	7 10	5	200	189842	10 66	8	189843	14 20	12
189872	8 48	5	189873	16 40	13	400	189874	23 10	19	189875	32 72	26
189888	12 20	8	189889	22 20	19	600	189890	33 30	29	189891	47 18	38
230526	21 46	10	230527	39 00	25	800	230528	58 50	36	230529	78 00	48
230534	23 38	15	230535	42 50	36	1000	230536	63 75	50	230537	85 00	67
230542	29 04	25	230543	52 80	48	1200	230544	79 20	77	230545	105 60	92
230550	38 50	30	230551	70 00	55	1600	230552	105 00	80	230553	140 00	105
230558	52 80	52	230559	96 00	98	2000	230560	144 00	144	230561	192 00	190
With Horizontally-Laminated Studs												
260410	38 50	38	260411	70 00	76	1600	260412	105 00	114	260413	146 00	156
260218	52 80	42	260219	96 00	84	2000	260220	144 00	124	260221	192 00	165
259622	128 00	52	.....	.....	.....	3000	259624	350 00	146	.....	.....	.....
259954	188 00	102	.....	.....	.....	4000	.....	.....	.....	.....	.....	.....
260110	250 00	159	.....	.....	.....	6000	.....	.....	.....	.....	.....	.....

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000 ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches, but not of laminated-stud switches.

Stops not included in style number or price. Refer to list at end of knife-switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Shipping Weights, see page 1044.

\*For 250 volts D.C. only.

†For 500 volts A.C.

‡All ratings below the 1200 ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. For the 1200 ampere and above the ratings are D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

250 VOLTS D-C. AND 500 VOLTS A-C.

Double-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
189804	\$ 1 38	1 1/2	189805	\$ 2 50	2	*30	189806	\$ 3 75	2 3/4	189807	\$ 5 00	3 1/2
280914	1 92	1 1/2	280915	3 46	2	‡30	280916	5 20	2 3/4	280917	7 00	3 1/2
189812	2 04	1 1/2	189813	3 70	2	60	189814	5 56	2 3/4	189815	7 40	3 1/2
189828	3 52	2	189829	6 40	4	100	189830	9 60	5 1/2	189831	12 80	8
189844	5 60	4	189845	10 20	7	200	189846	15 30	10	189847	20 40	15
189876	12 38	7	189877	22 50	17	400	189878	33 75	24	189879	45 00	35
189892	17 34	10	189893	31 50	27	600	189894	47 25	36	189895	63 00	52
230530	30 80	14	230531	56 00	35	800	230532	84 00	50	230533	112 00	68
230538	34 10	23	230539	62 00	63	1000	230540	93 00	78	230541	124 00	95
230546	42 90	35	230547	78 00	68	1200	230548	117 00	101	230549	156 00	137
230554	57 20	40	230555	104 00	71	1600	230556	156 00	104	230557	208 00	137
230562	79 20	70	230563	144 00	133	2000	230564	216 00	199	230565	288 00	262
With Horizontally-Laminated Studs												
260490	57 20	54	260491	104 00	114	1600	260492	156 00	168	260493	208 00	222
260298	79 20	59	260299	144 00	118	2000	260300	216 00	178	260301	288 00	236
259682	188 00	82	.....	.....	.....	3000	259684	521 00	245	.....	.....	.....
259994	264 00	139	.....	.....	.....	4000	.....	.....	.....	.....	.....	.....

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000 ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches, but not of laminated-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Shipping Weights, see page 1044.

\*For 250 volts D.C. only.

‡For 500 volts A.C.



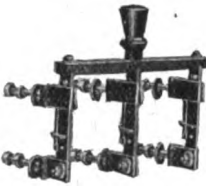




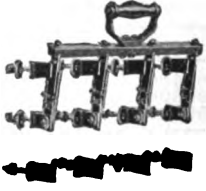
†All ratings below the 1200-ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. For the 1200-ampere and above the ratings are D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—With Quick-Break Attachments—Satin Finish

250 VOLTS D-C. AND 500 VOLTS A-C.

Single-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
												
280918	\$1 92	1	280919	\$ 3 54	1½	30	280920	\$ 5 34	2¼	280921	\$ 7 12	2½
189816	2 00	1	189817	3 70	1½	60	189818	5 55	2¼	189819	7 40	2½
189832	3 10	1½	189833	5 70	3	100	189834	8 60	4¼	189835	11 45	6
189848	4 60	2½	189849	8 45	5	200	189850	12 70	8	189851	16 90	12
189880	9 60	5	189881	17 65	13	400	189882	26 45	19	189883	37 20	26
189896	13 50	8	189897	24 75	19	600	189898	37 15	30	189899	52 30	39
230566	22 90	10	230567	41 90	25	800	230568	62 85	37	230569	83 80	50
230574	25 00	16	230575	45 70	36	1000	230576	68 55	53	230577	91 40	71
Double-Throw — Not Fused												
												
280922	2 90	1½	280923	5 40	2	30	280924	8 10	2¼	280925	10 85	3½
189820	3 05	1½	189821	5 70	2	60	189822	8 55	2¼	189823	11 40	3½
189836	4 60	2	189837	8 60	4	100	189838	12 90	5¼	189839	17 20	8
189852	6 95	4	189853	12 90	7	200	189854	19 40	10	189855	25 85	15
189884	14 60	7	189885	27 00	17	400	189886	40 50	25	189887	53 95	36
189900	19 90	10	189901	36 60	28	600	189902	54 95	37	189903	73 25	54
230570	33 70	14	230571	61 80	36	800	230572	92 70	52	230573	123 60	70
230578	37 30	25	230579	84 40	67	1000	230580	125 60	84	230581	136 80	103

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switches at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Shipping Weights, see page 1044.

†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

250 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
192151	\$ 1 24	1 1/4	192152	\$ 2 24	1 1/4	30	192153	\$ 3 36	2 1/4	192154	\$ 4 48	4
192163	1 88	1 1/4	192164	3 42	1 1/4	60	192165	5 15	2 1/4	192166	6 85	4
192187	3 52	2 1/4	192188	6 40	3 1/4	100	192189	9 60	5 1/2	192190	12 80	8
192211	5 30	5	192212	9 65	6 1/2	200	192213	14 50	10	192214	19 30	15
192235	11 30	9	192236	20 50	16	400	192237	30 75	24	192238	43 55	33
192259	16 35	13	192260	29 75	25	600	192261	44 60	41	192262	63 20	55
289223	27 05	18	289224	49 20	40	800	289225	73 80	65	289226	98 40	88
289235	30 60	23	289236	55 60	52	1000	289237	83 40	80	289238	111 20	111
289247	36 85	38	289248	67 00	72	1200	289249	100 50	122	289250	134 00	160
Double-Throw — Fused At Both Ends												
192159	2 64	1 1/4	192160	4 80	3	30	192161	7 20	5	192162	9 60	7
192171	3 08	1 1/4	192172	5 60	3	60	192173	8 40	5	192174	11 20	7
192195	5 50	3	192196	10 00	5 1/2	100	192197	15 00	11	192198	20 00	14
192219	8 60	5 1/2	192220	15 60	11	200	192221	23 40	19	192222	31 20	26
192243	18 45	11	192244	33 50	21	400	192245	50 25	43	192246	67 00	60
192267	25 10	16	192268	45 60	34	600	192269	68 40	73	192270	91 20	99
289231	42 90	25	289232	78 00	62	800	289233	117 00	95	289234	156 00	130
289243	48 70	34	289244	88 50	85	1000	289245	132 75	117	289246	177 00	167
289255	57 20	52	289256	104 00	111	1200	289257	156 00	163	289258	208 00	232

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Single-throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping Weights, see page 1044.









†All ratings below 1200-ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. For the 1200-ampere and above the ratings are D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—With Quick-Break Attachments—Satin Finish

250 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
												
192175	\$ 2 38	1 1/4	192176	\$ 4 42	1 3/4	60	192177	\$ 6 65	2 1/4	192178	\$ 8 85	4
192199	4 10	2 1/2	192200	7 50	3 1/2	100	192201	11 30	5 1/2	192202	15 05	8
192223	6 00	5	192224	11 00	6 1/2	200	192225	16 55	10	192226	22 05	15
192247	12 40	9	192248	22 75	16	400	192249	34 10	24	192250	48 05	34
192271	17 65	13	192272	32 30	25	600	192273	48 45	42	192274	68 30	57
289259	28 50	19	289260	52 10	42	800	289261	78 15	68	289262	104 20	92
289271	32 25	24	289272	58 90	54	1000	289273	88 35	83	289274	117 80	115
Double-Throw — Fused At Both Ends												
												
192183	4 08	1 1/4	192184	7 60	3	60	192185	11 40	5	192186	15 20	7
192207	6 60	3	192208	12 20	5 1/2	100	192209	18 30	11	192210	24 40	14
192231	9 95	5 1/2	192232	18 30	11	200	192233	27 50	19	192234	36 65	27
192255	20 70	11	192256	38 00	21	400	192257	56 95	44	192258	75 95	62
192279	27 65	16	192280	50 70	35	600	192281	76 10	76	192282	101 45	103
289267	45 80	27	289268	83 80	66	800	289269	125 70	101	289270	167 60	138
289279	52 00	36	289280	95 10	89	1000	289281	142 65	123	289282	190 20	175

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Single-Throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping Weights, see page 1044.

†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

500 VOLTS A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° A.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
192283	\$ 2 54	1 1/4	192284	\$ 4 37	1 1/4	30	192285	\$ 5 40	2 1/2	192286	\$ 7 20	3 1/4
192295	2 64	1 1/4	192296	4 70	1 1/4	60	192297	8 20	2 1/2	192298	8 30	3 1/4
192319	5 10	2 1/2	192320	7 45	3 1/2	100	192321	10 40	5	192322	13 90	6 1/2
192343	6 30	5	192344	10 65	6 1/2	200	192345	15 50	9 1/4	192346	20 70	12
192367	11 95	9	192368	21 25	16	400	192369	34 00	22 1/2	192370	45 35	30 1/2
192391	16 75	13	192392	30 65	25	600	192393	46 00	38 1/2	192394	61 35	52 1/2
289295	30 00	18	289296	52 00	40	800	289297	75 00	65	289298	100 00	88
289307	33 00	23	289308	90 00	52	1000	289309	68 00	80	289310	114 70	111
289319	40 00	28	289320	75 00	72	1100	289321	105 00	122	289322	140 00	160
Double-Throw — Fused At Both Ends												
192291	3 81	1 1/4	192292	5 70	3	30	192293	8 40	4 1/4	192294	11 20	6 1/4
192303	4 35	1 1/4	192304	7 05	3	60	192305	9 80	4 1/4	192306	13 08	6 1/4
192327	7 60	3	192328	11 15	5 1/2	100	192329	18 50	10 1/2	192330	24 68	13 1/2
192351	9 45	5 1/2	192352	16 50	11	200	192353	26 00	18 1/4	192354	34 68	26
192375	19 40	11	192376	37 90	21	400	192377	54 50	43	192378	72 68	59
192399	27 95	16	192400	48 95	34	600	192401	75 00	72 1/2	192402	100 00	96 1/2
289303	45 00	25	289304	86 60	62	800	289305	130 00	95	289306	173 00	130
289315	50 00	34	289316	95 90	85	1000	289317	144 00	117	289318	192 00	167
289327	70 00	52	289328	120 00	111	1100	289329	168 00	163	289330	224 00	232





Satin Finish included in style number and price.  
 Polished Finish, add 10 per cent to satin finish price.  
 Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.  
 Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.  
 Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."  
 Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.  
 Stops not included in style number or price. Refer to list at end of knife switch tables.  
 Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Square Posts regularly supplied on all switches.  
 Single-Throw Switches Fused at Top can be furnished on special request.  
 Fuses not included in style number and price. See pages 1017 and 1018.  
 Shipping Weights, see page 1044.  
 †All ratings below the 1100-ampere are A.C. on either the 20- or 30-degree rise basis. For the 1100-ampere the rating is A.C. on the 30-degree rise basis. For reduced ratings on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued




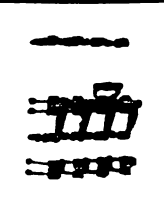
TYPE A SWITCHES

Rear-Connected—With Quick-Break Attachments—Satin Finish

500 VOLTS A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
						Max. Amps. 30° A.C. Rating†						
Single-Pole			Double-Pole				Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	
195313	\$ 2 88	1 1/4	195314	\$ 4 56	1 1/4	30	195315	\$ 6 84	2 1/2	195316	\$ 9 12	3 1/4
192307	3 25	1 1/4	192308	5 15	1 1/4	60	192309	7 70	2 1/2	192310	10 28	3 1/4
192331	5 21	2 1/2	192332	8 07	3 1/2	100	192333	12 08	5	192334	16 12	6 1/2
192355	7 58	5	192356	11 71	6 1/2	200	192357	17 54	9 1/4	192358	23 40	12
192379	16 22	9	192380	24 89	16	400	192381	37 35	22 1/2	192382	49 82	30 1/2
192403	21 68	13	192404	33 21	25	600	192405	49 84	38 3/4	192406	66 46	52 1/2
289331	31 45	18	289332	54 90	40	800	289333	79 35	65	289334	105 80	88
289343	34 65	23	289344	63 30	52	1000	289345	90 95	80	289346	121 30	111
289355	41 90	38	289356	78 80	72	1100	289357	110 75	122	289358	147 65	160

Double-Throw — Fused At Both Ends												
						Max. Amps. 30° A.C. Rating†						
Single-Pole			Double-Pole				Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	
195321	4 71	1 1/4	195322	7 52	3	30	195323	11 28	4 1/4	195324	15 04	6 1/4
192316	5 35	1 1/4	192316	5 65	3	60	192317	12 80	4 1/4	192318	17 08	6 1/4
192339	6 32	3	192340	14 54	5 1/2	100	192341	21 80	10 1/4	192342	29 08	13 1/2
192363	12 86	5 1/2	192364	20 02	11	200	192365	30 08	18 1/4	192366	40 12	26
192367	26 44	11	192368	40 78	21	400	192369	61 22	43	192390	81 64	59
192411	35 86	16	192412	55 07	34	600	192413	82 68	72 1/2	192414	110 24	96 1/2
289339	47 90	25	289340	97 80	62	800	289341	115 00	95	289342	152 50	130
289351	53 30	34	289352	108 00	85	1000	289353	164 00	117	289354	217 00	167
289363	73 80	52	289364	127 65	111	1100	289365	186 00	163	289366	230 00	232

Satin Finish included in style number and price.  
 Polished Finish, add 10 per cent to satin finish price.  
 Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.  
 Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.  
 Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000 ampere switch at regular price. For additional terminals refer to pages under "switchboard details."  
 Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.  
 Stops not included in style number or price. Refer to list at end of knife switch tables.  
 Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Square Posts regularly supplied on all switches.  
 Single-Throw Switches Fused at Top can be furnished on special request.  
 Fuses not included in style number and price. See pages 1017 and 1018.  
 Shipping Weights, see page 1044.  
 †All ratings below the 1100 ampere are A.C. on either the 20- or 30-degree rise basis. For the 1100 ampere the rating is A.C. on the 30-degree rise basis. For reduced ratings on the 20-degree rise basis see page 1019.



KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
280926	\$ 1 84	1½	280927	\$ 3 32	2½	30	280928	\$ 5 34	4	280929	\$ 7 34	5
192683	1 94	1½	192684	3 50	2½	60	192685	5 60	4	192686	7 70	5
192699	3 04	1½	192700	5 50	3½	100	192701	8 80	6	192702	12 10	8
192715	4 60	3	192716	8 25	6	200	192717	13 30	10	192718	18 40	15
192747	9 90	6	192748	17 75	16	400	192749	28 65	25	192750	39 50	31
192763	14 10	9	192764	25 45	23	600	192765	40 95	34	192766	56 50	48
230715	23 30	11	230716	49 95	28	800	230717	66 05	39	230718	89 15	54
230723	39 80	16	230724	72 20	39	1000	230725	108 40	54	230726	144 40	73
230731	49 00	27	230732	91 20	52	1200	230733	125 50	77	230734	183 50	103
230739	64 90	32	230740	122 50	59	1600	230741	165 60	86	230742	239 70	113
230747	87 75	55	230748	162 90	104	2000	230749	237 55	153	230750	304 80	212
With Horizontally-Laminated Studs												
280394	64 90	40	280395	122 50	80	1600	280396	165 60	121	280397	239 70	165
280202	87 75	43	280203	162 90	86	2000	280204	237 57	129	280205	304 80	172
259610	218 00	54	.....	.....	.....	3000	259612	595 00	162	.....	.....	.....
259946	320 00	105	.....	.....	.....	4000	.....	.....	.....	.....	.....	.....
280108	425 00	165	.....	.....	.....	6000	.....	.....	.....	.....	.....	.....

Satin Finish included in style number and price.  
 Polished Finish, add 10 per cent to satin finish price.  
 Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.  
 Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.  
 Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."  
 Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches, but not of laminated-stud switches.  
 Stops not included in style number or price. Refer to list at end of knife switch tables.  
 Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Square Posts regularly supplied on all switches.  
 Shipping Weights, see page 1044.  
 †All ratings below the 1200 ampere are D.C. or A.C. on either the 20- or 30-degree rise basis. For the 1200 ampere and above, the ratings are D.C. on the 30-degree rise basis. For reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

600 VOLTS D-C. AND A-C.

Double-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. 30° D.C. Rating†	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
280930	\$ 2 70	2	280931	\$ 4 86	3½	30	280932	\$ 7 80	5½	280933	\$10 74	7
192687	2 80	2	192688	5 10	3½	60	192689	8 18	5½	192690	11 22	7
192703	4 08	2½	192704	7 40	5	100	192705	11 74	10	192706	16 28	12
192719	6 02	4½	192720	10 70	9	200	192721	17 35	16	192722	24 05	22
192751	13 15	8	192752	23 50	21	400	192753	38 10	37	192754	52 65	48
192767	18 35	12	192768	32 90	31	600	192769	53 10	48	192770	73 35	63
230719	42 30	15	230720	64 60	38	800	230721	86 25	55	230722	119 50	74
230727	58 00	25	230728	105 30	69	1000	230729	158 00	86	230730	211 00	107
230735	72 70	25	230736	123 55	69	1200	230737	175 00	86	230738	246 35	107
230743	98 05	42	230744	163 60	75	1600	230745	212 10	110	230746	311 40	145
230751	126 70	73	230752	215 30	139	2000	230753	296 35	208	230754	436 90	274
With Horizontally-Laminated Studs												
260458	98 05	56	260459	163 60	118	1600	260460	212 10	173	260461	311 40	228
260266	126 70	61	260267	215 30	122	2000	260268	296 35	183	260269	436 90	243
259658	282 00	84	.....	.....	.....	3000	259660	781 00	251	.....	.....	.....
259978	396 00	142	.....	.....	.....	4000	.....	.....	.....	.....	.....	.....
260122	552 00	238	.....	.....	.....	6000	.....	.....	.....	.....	.....	.....

Satin Finish included in style number and price.  
 Polished Finish, add 10 per cent to satin finish price.  
 Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.  
 Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.  
 Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."  
 Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches, but not of laminated-stud switches.  
 Stops not included in style number or price. Refer to list at end of knife switch tables.  
 Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Square Posts regularly supplied on all switches.  
 Shipping Weights, see page 1044.  
 †All ratings below the 1200-ampere are D.C. or A.C. on either the 20 or 30-degree rise basis. For the 1200-ampere and above the ratings are D.C. on the 30-degree rise basis; for reduced ratings on A.C. and on the 20-degree rise basis see page 1019.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—With Quick-Break Attachments—Satin Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Not Fused												
With Round Studs												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
280934	\$2 10	1 1/4	280935	\$ 3 82	2 1/4	30	280936	\$ 6 12	4	280937	\$ 8 44	5
192691	2 20	1 1/4	192692	4 00	2 1/4	80	192693	6 40	4	192694	8 80	5
192707	3 58	1 1/4	192708	6 50	3 1/4	100	192709	10 40	6	192710	14 30	8
192723	5 28	3	192724	9 60	6	200	192725	15 36	10	192726	21 12	15
192755	11 00	6	192756	20 00	16	400	192757	32 00	25	192758	44 00	32
192771	15 40	9	192772	28 00	23	600	192773	44 80	35	192774	61 60	50
230755	24 75	11	230756	52 85	29	800	230757	70 45	40	230758	95 00	56
230763	41 40	17	230764	75 40	41	1000	230765	113 20	57	230766	150 80	77
Double-Throw — Not Fused												
280938	3 22	2	280939	5 74	3 1/4	30	280940	9 24	5 1/2	280941	12 72	7
192695	3 30	2 1/2	192696	6 00	3 1/4	60	192697	9 60	5 1/2	192698	13 20	7
192711	4 96	2 1/2	192712	9 00	5	100	192713	14 40	10	192714	19 80	12
192727	7 38	4 1/2	192728	13 40	9	200	192729	21 44	16	192730	29 48	22
192759	15 40	8	192760	28 00	21	400	192761	44 80	38	192762	61 60	50
192775	20 90	12	192776	38 00	32	600	192777	60 80	50	192778	83 60	65
230759	45 25	15	230760	70 45	39	800	230761	95 00	57	230762	131 20	77
230767	61 20	27	230768	117 70	73	1000	230769	167 60	92	230770	223 80	115

Satin Finish included in style number and price.  
 Polished Finish—add 10 per cent to satin finish price.  
 Plain Finish—30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.  
 Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.  
 Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."  
 Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.  
 Stops not included in style number or price. Refer to list at end of knife switch tables.  
 Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.  
 Square Posts regularly supplied on all switches.  
 Shipping Weights, see page 1044.  
 †All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—Without Quick-Break Attachments—Satin Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
192779	\$2 34	1 1/4	192780	\$ 4 22	2	30	192781	\$ 6 78	2 1/4	192782	\$ 9 32	3
192791	2 60	1 1/2	192792	4 70	2 1/4	60	192793	7 52	3 1/2	192794	10 34	4 1/2
192815	4 08	3	192816	7 40	4	100	192817	11 84	7	192818	16 28	9
192839	6 25	5	192840	11 25	7 1/2	200	192841	18 10	12	192842	25 00	16
192863	13 45	9	192864	24 35	18	400	192865	39 05	28	192866	53 80	36
192887	18 80	14	192888	33 95	28	600	192889	54 55	45	192890	75 70	60
Double-Throw — Fused At Both Ends												
192787	3 18	1 1/4	192788	5 76	3	30	192789	9 24	5 1/2	192790	12 72	6
192799	3 58	2	192800	6 50	4	60	192801	10 40	7	192802	14 30	8
192823	6 06	4	192824	11 00	7	100	192825	17 60	14	192826	24 20	15
192847	8 80	6 1/2	192848	15 80	13	200	192849	25 50	22	192850	35 25	30
192871	18 10	13	192872	32 50	25	400	192873	52 50	50	192874	72 45	65
192895	26 05	20	192896	46 90	40	600	192897	75 50	80	192898	104 15	110

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000 ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Single-Throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping Weights, see page 1044.

†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE A SWITCHES

Rear-Connected—With Quick-Break Attachments—Satin Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Round Studs												
Single-Pole			Double-Pole			Max. Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
195893	\$2 66	1½	195894	\$ 4 82	2	30	195895	\$ 7 74	2½	195896	\$10 64	3
192803	2 96	1½	192804	5 40	2½	60	192805	8 64	3½	192806	11 88	4½
192827	4 68	3	192828	8 50	4	100	192829	13 60	7	192830	18 70	9
192851	6 94	5	192852	12 60	7½	200	192853	20 16	12	192854	27 72	16
192875	14 58	9	192876	26 50	18	400	192877	42 40	28	192878	58 30	36
192899	20 08	14	192900	36 50	28	600	192901	58 40	45	192902	80 30	60
Double-Throw — Fused At Both Ends												
195901	3 74	1½	195902	6 88	3	30	195903	10 84	5½	195904	14 92	6
192811	4 14	2	192812	7 50	4	60	192813	12 00	7	192814	16 50	8
192835	6 88	4	192836	12 50	7	100	192837	20 00	14	192838	27 50	15
192859	10 18	6½	192860	18 50	13	200	192861	29 60	22	192862	40 70	30
192883	20 36	13	192884	37 00	25	400	192885	59 20	50	192886	81 40	65
192907	28 60	20	192908	52 00	40	600	192909	83 20	80	192910	114 40	110

Satin Finish included in style number and price.

Polished Finish, add 10 per cent to satin finish price.

Plain Finish, 30 to 400 amperes inclusive deduct 10 per cent from satin finish price; above 400 amperes deduct 5 per cent.

Bases not included in style number or price. For switches mounted on wood templates, slate or marble bases, add 10, 15 or 20 per cent respectively to the list price.

Terminals included in style number and price on one stud per pole on single-throw and on two studs per pole on double-throw switches 800 amperes and below. If specified at entry of order, they will be similarly supplied on the 1000-ampere switch at regular price. For additional terminals refer to pages under "switchboard details."

Sufficient Nuts per stud, to clamp the switch and to make connections to carry the rated current, are included in price of round-stud switches.

Stops not included in style number or price. Refer to list at end of knife switch tables.

Spade Handles included in style number and price for all four-pole switches and all three-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Square Posts regularly supplied on all switches.

Single-Throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping Weights, see page 1044.



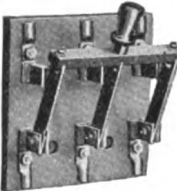





†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE C SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

250 VOLTS D-C. AND 500 VOLTS A-C.

Single-Throw — Not Fused												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
												
228322	\$0 42	½	228326	\$ 68	1	*30	228330	\$1 02	1¾	228335	\$1 36	3
254398	66	1	254399	1 08	2¼	†30	228331	1 60	4	228336	2 14	7
228323	74	1	228327	1 22	2¼	60	228332	1 84	4	228337	2 44	7
228324	1 50	1½	228328	2 50	3	100	228333	3 76	5¾	228338	5 00	11
228325	2 70	2½	228329	4 50	5	200	228334	6 76	9	228339	9 00	15
Double-Throw — Not Fused												
												
228340	76	1¼	228344	1 16	2	*30	228348	1 80	3¼	228353	2 56	6¼
254398	1 18	2	254399	1 70	3¾	†30	228349	2 66	6½	228354	3 84	12
228341	1 30	2	228345	2 00	3¾	60	228350	3 10	6½	228355	4 40	12
228342	2 94	3¼	228346	4 50	6¼	100	228351	6 90	9	228356	9 80	17
228343	4 88	5	228347	7 50	9	200	228352	11 60	17	228357	15 50	19

Plain Finish included in style number and price.

Satin Finish, add 30 per cent.

Polished Finish, add 10 per cent to price of satin finish.

Slate Bases included in style number and price.

Unmounted Switches, deduct 10 per cent.

Terminals included in style number and price.

Spade Handles included in style number and price for all 4-pole switches and all 3-pole switches above 600 amperes. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Quick-Break Attachments, see page 1043 for additional price.

\*For 250 volts D.C. only.

†For 500 volts A.C.




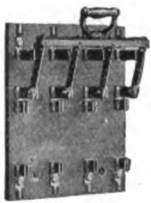




‡All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE C SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

250 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
						Amps. †						
Single-Pole			Double-Pole				Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
228358	\$ 70	1	228362	\$1 06	2	30	228366	\$1 60	3½	228370	\$2 12	6¼
228359	1 18	2	228363	1 80	3½	60	228367	2 70	5½	228371	3 60	10½
228360	2 38	3¼	228364	3 66	7¼	100	228368	5 50	10¾	228372	7 30	18
228361	4 40	5	228365	6 76	10¼	200	228369	10 14	16¾	228373	13 50	30
Double-Throw — Fused At Both Ends												
						Amps. †						
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.			Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.
228390	1 54	2¼	228394	2 20	4	30	228398	3 52	6¼	228402	4 84	13¼
228391	2 38	4	228395	3 40	7½	60	228399	5 44	13	228403	7 48	24
228392	5 18	6½	228396	7 40	12½	100	228400	11 84	18	228404	16 28	34
228393	9 80	10	228397	13 00	16	200	228401	20 80	32	228405	26 60	54




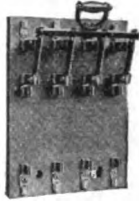




Plain Finish included in style number and price.  
 Satin Finish, add 30 per cent.  
 Polished Finish, add 10 per cent to price of satin finish.  
 Slate Bases included in style number and price.  
 Unmounted Switches, deduct 10 per cent.  
 Terminals included in style number and price.  
 Spade Handles included in style number and price for all 4-pole switches. Straight handles are included on all other switches.  
 For price of spade handles refer to page 1044.  
 Quick-Break Attachments, see page 1043 for additional price.  
 Single-Throw Switches Fused at Top can be furnished on special request.  
 Fuses not included in style number and price. See pages 1017 and 1018.  
 Shipping Weights, see page 1044.  
 †All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE C SWITCHES

Front-Connected—Without Quick-Break Attachments—Plain Finish

500 VOLTS A-C.

Single-Throw — Fused At Bottom												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
254484	\$1 25	2½	254485	\$1 85	4¾	30	228408	\$2 80	7	228410	\$3 70	13
254490	1 55	3	254491	2 35	5¾	60	228407	3 50	8¾	228411	4 80	16
254496	3 10	4	254497	4 65	8½	100	228408	7 00	13	228412	9 30	25
254502	5 30	7	254503	7 90	15	200	228409	12 20	20	228413	16 20	40
Double-Throw — Fused At Both Ends												
												
254488	2 34	5½	254489	3 28	8½	30	228422	6 00	11	228426	8 00	20
254494	2 92	6	254495	4 28	11	60	228423	7 40	16	228427	9 80	30
254500	6 14	8½	254501	8 80	16½	100	228424	14 00	24	228428	18 80	45
254506	10 08	14	254507	14 30	22	200	228425	21 50	40	228429	28 80	75

Plain Finish included in style number and price.

Satin Finish, add 30 per cent.

Polished Finish, add 10 per cent to price of satin finish.

Slate Bases included in style number and price.

Unmounted Switches, deduct 10 per cent.

Terminals included in style number and price.

Spade Handles included in style number and price for all 4-pole switches. Straight handles are included on all other switches. For price of spade handles refer to page 1044.

Quick-Break Attachments, see page 1043 for additional price.

Single-Throw Switches Fused at Top can be furnished on special request.

Fuses not included in style number and price. See pages 1017 and 1018.

Shipping Weights, see page 1044.

†All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.


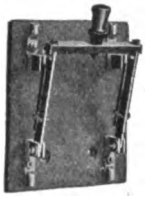





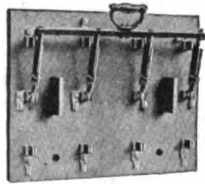


KNIFE SWITCHES—Continued

TYPE C SWITCHES

Front-Connected—With or Without Quick-Break Attachments—Plain Finish

600 VOLTS D-C. AND A-C.

Single-Throw — Not Fused												
With Quick-Break Attachments												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
254440	\$1 08	2	254441	\$1 80	4 1/4	30	254442	\$2 80	6	254443	\$3 80	9
254420	1 20	2 1/4	254421	2 00	5 1/4	60	254422	3 10	7	254423	4 20	10
254428	2 18	3	254429	3 60	8	100	254430	5 60	13	254431	7 50	18
228433	4 20	5	228437	7 00	13	200	228441	10 88	24	254436	14 70	30
Without Quick-Break Attachments												
228430	0 80	2	228434	1 34	4 1/4	30	228438	2 10	6	254438	2 80	9
228431	98	2 1/4	228435	1 60	5 1/4	60	228439	2 50	7	254408	3 30	10
228432	1 90	3	228436	3 18	8	100	228440	4 90	13	254410	6 60	18
Double-Throw — Not Fused												
With Quick-Break Attachments												
												
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Amps. †	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
254444	2 50	2 1/4	254445	3 88	9	30	254446	6 22	14	254447	8 36	18
254424	2 82	2 3/4	254425	4 44	10	60	254426	7 06	15	254427	9 68	20
254432	4 90	4	254433	7 20	13	100	254434	11 60	23	254435	16 00	31
228445	8 64	7 1/2	228449	13 08	20	200	228453	20 97	35	254437	28 76	47
Without Quick-Break Attachments												
228442	1 66	2 1/4	228446	2 20	9	30	228450	3 70	14	254439	5 00	18
228443	1 90	2 3/4	228447	2 60	10	60	228451	4 30	15	254409	6 00	20
228444	3 90	4	228448	5 20	13	100	228452	8 60	23	254411	12 00	31



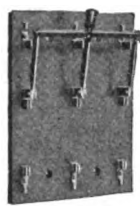
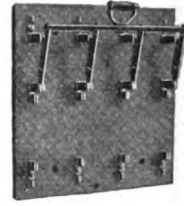




Plain Finish included in style number and price.  
 Satin Finish, add 30 per cent.  
 Polished Finish, add 10 per cent to price of satin finish.  
 Slate Bases included in style number and price.  
 Unmounted Switches, deduct 10 per cent.  
 Terminals included in style number and price.  
 Spade Handles included in style number and price for all 4-pole switches. Straight handles are included on all other switches.  
 For price of spade handles refer to page 1044.  
 Quick-Break Attachments, see page 1043 for additional price.  
 Shipping Weights, see page 1044.  
 †All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPE C SWITCHES

Front-Connected—With or Without Quick-Break Attachments—Plain Finish

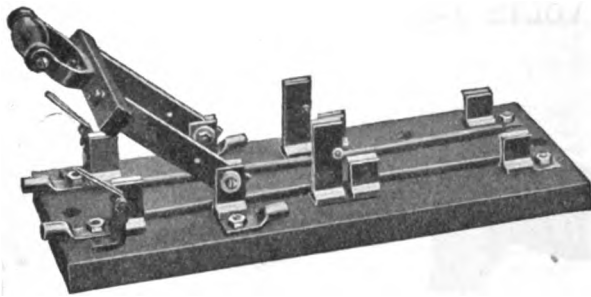
600 VOLTS D-C. AND A-C.

Single-Throw — Fused At Bottom												
With Quick-Break Attachments												
												
Single-Pole			Double-Pole			Amps. †	Three-Pole			Four-Pole		
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.		Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
254599	\$1 70	2 3/4	254600	\$2 60	7	30	254601	\$4 16	13	254602	\$ 5 70	18
254611	1 98	3 3/4	254612	3 00	8	60	254613	4 80	14	254614	6 60	20
254623	3 60	7	254624	5 50	17	100	254625	8 80	28	254626	12 00	38
228457	6 50	15	228461	10 00	29	200	228465	10 00	43	254635	22 00	61
Without Quick-Break Attachments												
228454	1 40	2 3/4	228458	2 20	7	30	228462	3 50	13	254578	5 70	18
228455	1 70	3 3/4	228459	2 60	8	60	228463	4 16	14	254581	6 60	20
228456	3 25	7	228460	5 00	17	100	228464	8 00	28	254584	12 00	38
Double-Throw — Fused At Both Ends												
With Quick-Break Attachments												
												
Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Amps. †	Style No.	List Price Ea.	Net Wt. Lbs. Ea.	Style No.	List Price Ea.	Net Wt. Lbs. Ea.
254607	4 02	8	254608	5 84	13	30	254609	9 42	23	254610	12 88	33
254619	4 51	8 1/2	254620	6 52	14	60	254621	10 53	25	254622	14 54	35
254631	8 32	13	254632	11 64	27	100	254633	18 96	49	254634	26 28	66
228481	12 54	24	228485	19 38	46	200	228489	30 82	71	254637	39 76	98
Without Quick-Break Attachments												
228478	3 30	8	228482	4 40	13	30	228486	7 26	23	254580	10 00	33
228479	3 75	8 1/2	228483	5 00	14	60	228487	8 25	25	254583	11 50	35
228480	7 50	13	228484	10 00	27	100	228488	16 50	49	254586	23 00	66

Plain Finish included in style number and price.  
 Satin Finish, add 30 per cent.  
 Polished Finish, add 10 per cent to price of satin finish.  
 Slate Bases included in style number and price.  
 Unmounted Switches, deduct 10 per cent.  
 Terminals included in style number and price.  
 Spade Handles included in style number and price for all 4-pole switches. Straight handles are included on all other switches.  
 For price of spade handles refer to page 1044.  
 Quick-Break Attachments, see page 1043 for additional price.  
 Shipping Weights, see page 1044.  
 †All ratings are D.C. or A.C. on either the 20- or 30-degree rise basis.

KNIFE SWITCHES—Continued

TYPES A AND C MOTOR STARTING SWITCHES



TYPE C TWO-POLE MOTOR STARTING SWITCH

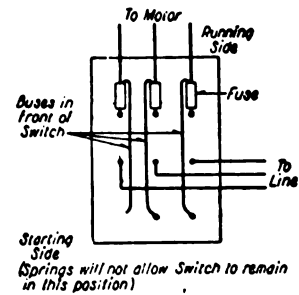


DIAGRAM OF CONNECTIONS FOR THREE-POLE SWITCH

Application

The starting current of induction motors is several times the normal running current and, when the controlling switch is fused to carry the running load only, the fuses are apt to blow on starting. The fuses must be of a capacity to prevent overloads under running conditions. These switches are designed to meet this difficulty and are used without auto-starters to control motors up to 5-horse-power rating.

Construction

These switches are arranged for National Electric

Code Fuses on one end only and have springs on the other end to open the switch automatically if left closed at this end. The corresponding terminals at both ends of the switch are connected so that the wiring need be connected to one set of these terminals only, thus decreasing the number of connections necessary. See accompanying diagram.

In starting an induction motor by this switch, the switch is thrown to the end that is not fused and held there until the motor is up to running speed; then it is quickly thrown to the fused position, thus protecting the circuit under running conditions.

PRICES

Switches Fused at One End Only, With Spring Throw-Out at Other End

Style number and list price include switch without fuses.

Amp.	Volts	TWO-POLE			THREE-POLE			FOUR-POLE		
		Wt. Lb. Boxed	Style No.	List Price	Wt. Lb. Boxed	Style No.	List Price	Wt. Lb. Boxed	Style No.	List Price
<b>Type A Switches</b>										
30	250	8	228490	\$ 4 12	12	228492	\$ 5 50	16	228494	\$ 7 30
60	250	12½	228491	5 50	18	228493	7 30	25	228495	9 75
30	500	19	228496	5 25	28	228498	7 00	38	228500	9 30
60	500	25	228497	6 50	37	228499	8 60	50	228501	11 50
30	600	....	.....	.....	35	182945	9 00	....	.....	.....
<b>Type C Switches</b>										
30	250	8	228502	3 75	12	228504	5 00	15½	228506	6 68
60	250	12	228503	4 75	17	228505	6 30	12½	228507	8 40
100	250	15½	254848	9 90	24	254849	13 20	....	.....	.....
30	500	13	228508	4 50	18	228510	6 00	27	228512	8 00
60	500	13½	228509	5 60	18½	228511	7 50	27½	228513	10 00

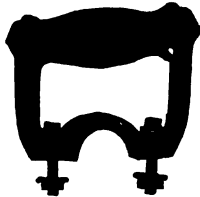
Quick-Break Attachments

For types A and C Front-Connected switches add the following list per pole per throw to the list price of the 250 or 500-volt switches without quick-break attachments, or deduct from the list price of the 600-volt switch with quick-break attachments 200 amperes and above.

Amp.	LIST PRICE	
	Plain Finish	Satin Finish
30	\$0 36	\$0 48
60	38	50
100	40	56
200	46	68
400	80	1 12
600	92	1 28
800	1 15	1 50
1000	1 50	2 00

KNIFE SWITCHES—Continued

SPADE HANDLES FOR TYPES A AND C FRONT AND REAR-CONNECTED KNIFE SWITCHES, 250 AND 600 VOLTS D-C. AND A-C., AND 500 VOLTS A-C.



STYLE No. 272989



STYLE No. 272987



STYLE No. 272994



STYLE No. 272993

Style number and list price include mounting screws. List prices are in addition to the regular list prices of complete switches, except on switches regularly equipped with spade handles.

D.C. Amps.	Poles	Style No.	List Price	D.C. Amps.	Poles	Style No.	List Price
30 and 60	2 or 4	272987	\$0 48	400 to 600	2 or 4	272991	\$1 20
30 and 60	3	272989	48	400 to 600	3	272992	1 20
100 and 200	2 or 4	272988	75	800 to 2000	2 or 4	272993	2 25
100 and 200	3	272990	75	800 to 2000	3	272994	2 25
				3000	3	272996	3 00

STOPS FOR TYPE A FRONT AND REAR-CONNECTED KNIFE SWITCHES, 250 AND 600 VOLTS

This attachment will stop the switch when open at an angle of 90 degrees, and will prevent the blade from swinging all the way down.

Stops are often required on switchboard and other work where the space is limited and switches or other live parts are brought close together as would be caused by throwing the switch all the way back, allowing it to come in contact with live parts of other apparatus underneath the switch. On double-throw switches, the stop is many times required to prevent the blade from engaging the lower contacts

of the switch when it is desired to have both throws "dead."

The stops listed below can be added to the standard switches by removing the hinge screw and nut and placing the stop next to the jaw blade under the cup washer and replacing the hinge screw and nut. Stops cannot be furnished for addition to 30 and 60-ampere switches which have been built, due to the difference in construction from the higher capacity switches; namely, that a rivet is used instead of a screw. Stops for 30 and 60-ampere switches can be supplied on order with the switch; price on request.

Amps.	Single-Throw Without or With Quick Break Style No.	Double-Throw Without or With Quick Break Style No.	Amps.	Single-Throw Without or With Quick Break Style No.	Double-Throw Without or With Quick Break Style No.
100	286886	286911	1200	286892	286917
200	286887	286912	1600	286893	286918
400	286889	286914	2000	286893	286918
600	286890	286915	3000	286895	286920
800	286891	286916	4000	286895	286920
1000	286892	286917	6000	286896	286921

Prices on stops will be supplied on request.

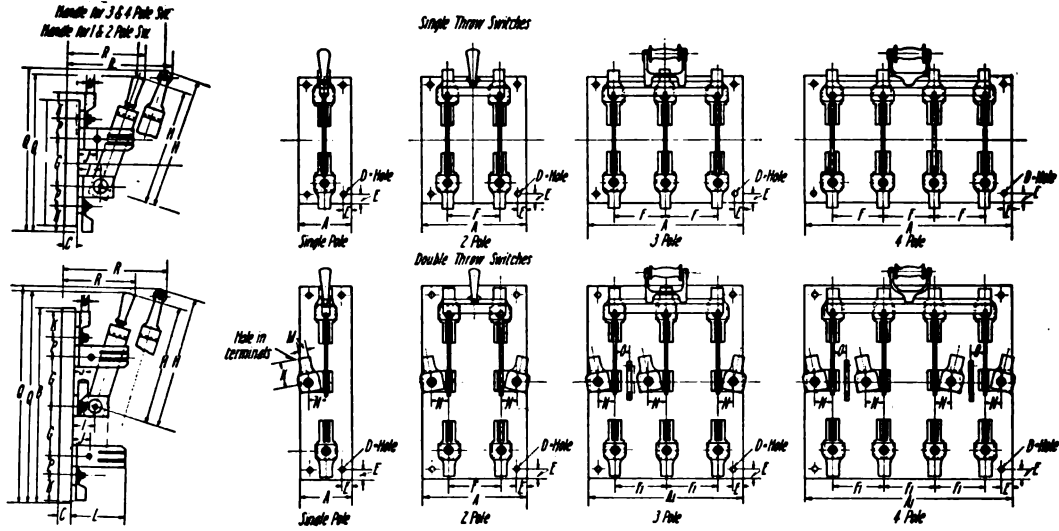
Shipping weights for types A and C front and rear-connected knife switches:

- If net weight is less than 3 pounds add 1/2 pound to get approximate unit shipping weight.
- If net weight is 3 to 7 pounds add 1 pound to get approximate unit shipping weight.
- If net weight is 7 to 20 pounds add 2 pounds to get approximate unit shipping weight.
- If net weight is above 20 pounds add 50 per cent to get approximate unit shipping weight.



KNIFE SWITCHES—Continued

TYPE A FRONT-CONNECTED—NOT FUSED



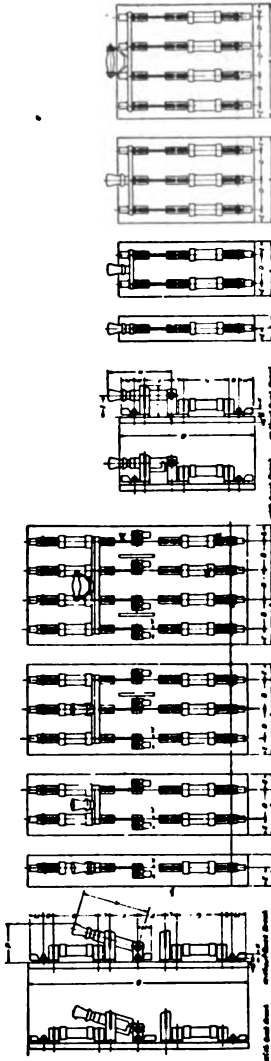
DIMENSIONS IN INCHES

Volts	Amps.	A		B		C	D	E	F	G	H				I		J	K		
		S. P.	2 P.	3 P.	4 P.						Single Throw	Double Throw	Single Throw	Double Throw						
		S. P.	2 P.	3 P.	4 P.															
250 Volts, D.C. and 500 Volts, A.C.	800	7	12	16	24	16	24	1 1/2	1 1/8	1 1/8	4 3/8	5 1/2	13 1/2	13 1/2	14 3/8	14 3/8	2 3/4	2 3/8	2 1/2	3 3/8
	1000	7	12	17	24	16	24	2	1 1/8	1 1/8	5	6	14 3/8	14 3/8	15 1/4	15 1/4	3 1/2	3 3/4	2 1/2	4 1/8
	1200 D.C. 1100 A.C.	7	14	20	24	16	24	2	1 1/8	1 1/8	5 1/8	6	14 3/8	14 3/8	15 1/2	15 1/2	3 1/2	3 3/4	2 3/8	4 3/8
			L	M	N	O	P	Q				R				A1			F1	
								S. T. 1 & 2 P. Sw.	S. T. 3 & 4 P. Sw.	D. T. 1 & 2 P. Sw.	D. T. 3 & 4 P. Sw.	S. T. 1 & 2 P. Sw.	S. T. 3 & 4 P. Sw.	D. T. 1 & 2 P. Sw.	D. T. 3 & 4 P. Sw.	D. T. S. P. Sw.	D. T. 3 P. Sw.	D. T. 4 P. Sw.	D. T. 3 & 4 P. Sw.	
		800	6 1/4	1.385	2	1 1/4	2 3/8	19 1/8	20 1/4	24 1/4	25 3/4	9 1/8	9 3/8	9 1/8	9 3/8	7	16	24	4 3/8	
	1000	6 3/4	1 1/2	1 3/8	1 1/8	2 3/8	20 3/8	21 1/8	26 1/8	27 1/8	9 3/8	10 1/8	9 3/8	9 7/8	7	17	24	5		
	1200 D.C. 1100 A.C.	7 1/8	1 3/4	2 1/8	1 3/8	2 3/8	21 1/8	22 1/8	27 1/8	28 1/8	10 3/8	10 3/8	10	10 1/8	10	24	27	6		

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

KNIFE SWITCHES—Continued

TYPE A FRONT-CONNECTED—FUSED



Volts A.C.	Amp.	Throw	DIMENSIONS IN INCHES											W									
			A	B	C	D	E	F	G	H	I	J	K		L	M	N	P	Q				
30	30	ST	2 1/4	7	1 1/2	3/4	2 1/4	1 1/2	2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
60	60	DT	2 1/2	10	1 3/4	3/4	2 3/4	1 3/4	2 1/2	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
100	100	DT	3	11	2	1	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
200	200	DT	3 1/2	11 1/2	2 1/4	1 1/4	3 1/4	2 1/4	3 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4
400	400	DT	4	12	2 1/2	1 1/2	3 1/2	2 1/2	3 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
600	600	DT	4 1/2	13	3	1 3/4	4	2 3/4	4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4
30	30	DT	2 1/2	7	1 1/2	3/4	2 1/4	1 1/2	2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
60	60	DT	2 3/4	10	1 3/4	3/4	2 3/4	1 3/4	2 1/2	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4	1 3/4
100	100	DT	3	11	2	1	3	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
200	200	DT	3 1/2	11 1/2	2 1/4	1 1/4	3 1/4	2 1/4	3 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4	2 1/4
400	400	DT	4	12	2 1/2	1 1/2	3 1/2	2 1/2	3 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2
600	600	DT	4 1/2	13	3	1 3/4	4	2 3/4	4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4	2 3/4

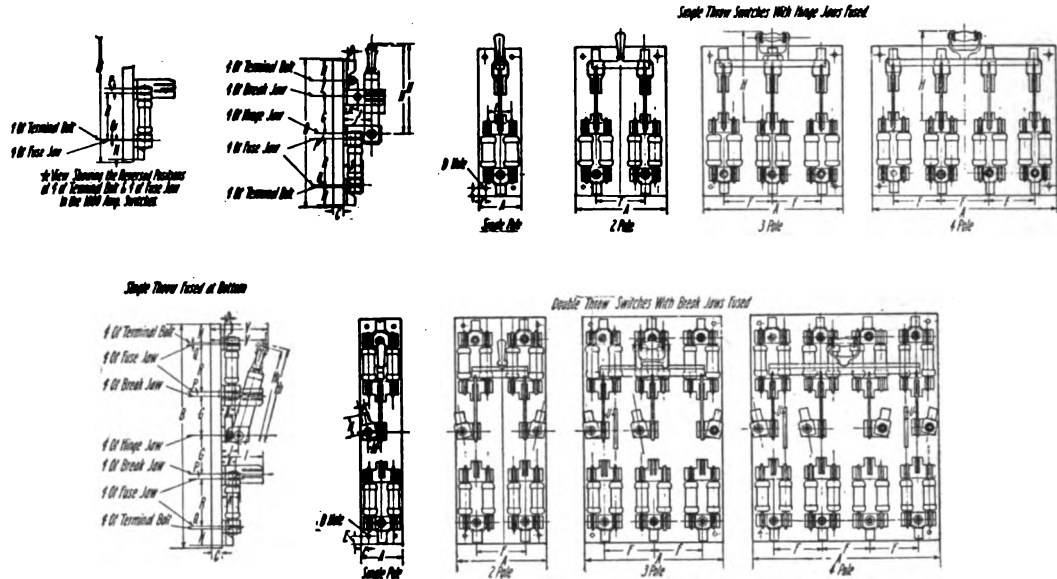
\*2 Pole Base 4'-0" long.

\*4 Pole base 2'-6" long  
 †2 Pole base 2" thick.

For official dimensions apply to the nearest District Office.

KNIFE SWITCHES—Continued

TYPE A FRONT-CONNECTED—FUSED



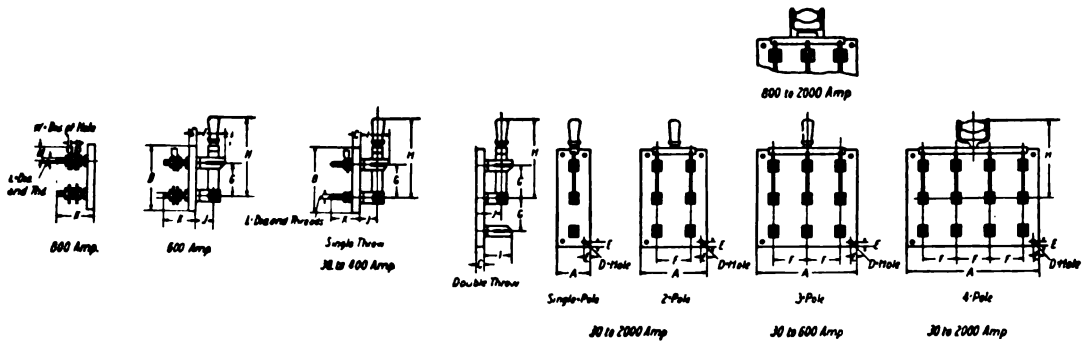
		DIMENSIONS IN INCHES																			
Volts	Amps.	A				B		C		D	E	F	G	H		H <sup>1</sup>		I			
		S. P.	2 P.	3 P.	4 P.	Single Throw	Double Throw	S. T.	D. T.					S. P. & 2 P.	3 P. & 4 P.	S. P. & 2 P.	3 P. & 4 P.				
250 D.C. & A.C.	800	8	16	24	32	24	36	1½	2	⅝	1⅝	7¼	5½	12½	13½	13½	14½	6¼			
	1000	9	20	28	36	28	40	2	2	⅞	1⅝	7⅝	6	13¾	14⅝	14⅝	15¼	6¾			
	1200 D.C. 1100 A.C.	9	20	28	36	28	40	2	2	⅞	1⅝	7⅝	6	13¾	14⅝	14⅝	15¼	7⅞			
500 A.C.	800	9	20	28	36	28	44	1½	2	⅝	1⅝	8¼	5½	12½	13½	13½	14½	6¼			
	1000	10	20	32	40	32	48	2	2	⅞	1⅝	9⅝	6	13¾	14⅝	14⅝	15¼	6¾			
	1100	10	20	32	40	32	48	2	2	⅞	1⅝	9⅝	6	13¾	14⅝	14⅝	15¼	7⅞			
		J				K	L	M	N	O	P	Q	R	S	T	U	V				Q
		Hinge Jaw Fused	Break Jaw Fused	D. T. Both Jaws Fused	S. T. 1 & 2 P.												S. T. 3 & 4 P.	D. T. 1 & 2 P.	D. T. 3 Lap	1, 2, 3 & 4 P. S. T. & D. T.	
250 D.C. & A.C.	800	4⅞	2⅝	2⅞	2½	2½	2	3⅞	1385	⅜	⅝	6¼	3⅝	3¼	2¼	9⅝	9⅝	9⅝	10⅞	☆	
	1000	4⅞	3⅝	3¼	2⅞	2½	1⅞	4⅞	1½	⅞	*	8⅝	3⅞	3¼	2⅞	9⅞	10⅞	9⅞	10⅞	☆	
	1200 D.C. 1100 A.C.	4⅞	3⅝	3¼	2⅞	2½	2⅞	2⅞	4⅞	1¼	⅞	⅞	8⅝	3⅞	3¼	2⅞	10⅞	10⅞	10	10⅞	☆
500 A.C.	800	4⅞	2⅝	2⅞	2½	2½	2	3⅞	1385	⅜	⅝	9¼	3⅝	3¼	3	9⅝	9⅝	9⅝	10⅞	☆	
	1000	4⅞	3⅝	3¼	2⅞	2½	1⅞	4⅞	1½	⅞	*	11⅝	3⅞	3¼	3⅝	9⅞	10⅞	9⅞	10⅞	☆	
	1100	4⅞	3⅝	3¼	2⅞	2½	2⅞	2⅞	1¼	⅞	⅞	11⅝	3⅞	3¼	3⅝	10⅞	10⅞	10	10⅞	☆	

These dimensions are for reference only. For official dimensions apply to the nearest District Office.



KNIFE SWITCHES—Continued

TYPE A REAR-CONNECTED—NOT FUSED



		DIMENSIONS IN INCHES																							
Volts	Amps.	A				B		C	D	E	F	G	H				I	J	K	L†	M	W			
		Single Pole	2 Pole	3 Pole	4 Pole	Single Throw	D'ble. Throw						Single Pole	2 Pole	3 Pole	4 Pole									
250 V. D.C. & A.C.	30	4	6	9	11	6	8	3/4	1/4	5/8	2 1/4	2	4 1/8	4 1/8	4 1/8	5 1/8	1 1/2	1	2 3/4	.242-24	..	..			
250 Volts D.C. or 500 V. A.C.	60	4	7	10	13	7	10	3/4	1/4	5/8	3	2 5/8	5 1/8	5 1/8	5 1/8	6 1/8	1 7/8	1 1/2	3	1/8-18	1 1/2	.259			
	100	5	8	11	14	8	11	3/4	1/4	5/8	3 1/8	3	6 1/8	6 1/8	6 1/8	7 1/8	2 1/8	1 1/2	3	3/8-16	1 3/8	.384			
	200	6	9	13	17	9	13	1	1/4	5/8	3 3/8	3 1/2	7 1/8	7 1/8	7 1/8	8 1/8	3	1 1/2	3 1/4	1/2-13	1 1/2	.558			
	400	6	10	14	19	10	15	1	1/4	5/8	4 1/8	4 1/2	9 1/8	9 1/8	9 1/8	10 1/8	4 1/8	2 1/8	3 3/4	5/8-11	2 1/8	.9185			
	600	7	11	16	20	12	16	1 1/4	1/4	5/8	4 1/2	4 7/8	10 1/4	10 1/4	10 1/4	11 3/8	4 3/8	2 3/4	4	3/4-16	3 1/2	1.28			
	800	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
	1000	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
	1200	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	*1100	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	*1200	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
2000	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
*1600	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
500 V A.C.	30	4	7	10	13	7	10	3/4	1/4	5/8	3	2 5/8	5 1/8	5 1/8	5 1/8	6 1/8	1 7/8	1 1/2	3	1/8-18	..	..			
600 Volts D.C. & A.C.	30	5	9	14	19	9	13	3/4	1/4	5/8	3 1/4	4 3/8	6 3/8	6 3/8	6 3/8	7 3/8	1 7/8	1 1/2	3	1/8-18	1 1/2	.259			
	60	5	9	14	19	9	13	3/4	1/4	5/8	3 1/4	4 3/8	6 3/8	6 3/8	6 3/8	7 3/8	1 7/8	1 1/2	3	1/8-18	1 1/2	.259			
	100	5	10	16	21	10	15	3/4	1/4	5/8	4 1/2	5 1/2	8 1/8	8 1/8	8 1/8	9 1/8	2 1/8	1 1/2	3	3/8-16	1 3/8	.384			
	200	6	12	18	24	12	17	1	1/4	5/8	5 1/2	6	9 1/8	9 1/8	9 1/8	10 3/8	3	1 1/2	3 1/4	1/2-13	1 1/2	.558			
	400	6	12	18	24	12	18	1	1/4	5/8	6	6	11 1/8	11 1/8	11 1/8	12 3/8	4 1/8	2 1/8	4	5/8-11	2 1/8	.9185			
	600	7	13	20	26	13	20	1 1/4	1/4	5/8	6 1/4	6 1/4	12	12	12	12 1/2	4 3/8	2 3/4	4 1/4	3/4-16	3 1/8	1.28			
	800	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
	1000	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	1200	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	*1100	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1600	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
*1200	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
2000	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
*1600	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	

Catalogue Style Number does not include base.

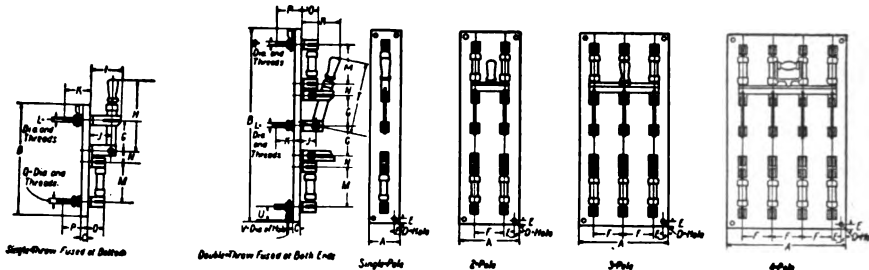
\*For 60-cycle alternating current only.

†Diameter in inches and number of threads to the inch.

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

KNIFE SWITCHES—Continued

TYPE A REAR-CONNECTED—FUSED



DIMENSIONS IN INCHES

Amp.	A			B			C	D	E	F	G	H		I
	Single-Pole	2 Pole	3 Pole	Single-Throw	Double-Throw	1, 2 & 3 Pole						4 Pole		
<b>250 Volts D-C. or A-C.</b>														
30	4	7	9	11	9	13	3/4	1/2	3/4	2 1/4	2	4 1/2	4 1/2	2 1/2
60	5	8	11	14	11	16	3/4	1/2	3/4	3	2 5/8	5 1/2	5 1/2	2 3/4
100	5	8	12	15	14	24	3/4	1/2	3/4	3 1/8	3	6 1/2	7	3 1/4
200	6	10	14	17	17	28	1	3/8	1	3 1/2	3 1/2	7 1/2	8 1/2	4 1/4
400	6	11	15	19	20	33	1	1/2	1 1/4	4 1/8	4 1/4	9 1/2	10 1/2	5 1/4
600	7	11	16	20	23	38	1 1/4	1/2	1 1/4	4 1/2	4 7/8	10 1/2	11 1/2	6 1/4
<b>500 Volts A-C.</b>														
30	5	8	11	14	13	21	3/4	1/2	3/4	3	2 5/8	5 1/2	5 1/2	2 1/2
60	5	8	11	14	13	21	3/4	1/2	3/4	3	2 5/8	5 1/2	5 1/2	2 3/4
100	5	8	12	15	16	28	3/4	1/2	3/4	3 1/8	3	6 1/2	7	3 1/4
200	6	10	14	17	20	33	1	3/8	1	3 1/2	3 1/2	7 1/2	8 1/2	4 1/4
400	6	11	15	19	23	39	1	1/2	1 1/4	4 1/8	4 1/4	9 1/2	10 1/2	5 1/4
600	7	11	16	20	26	44	1 1/4	1/2	1 1/4	4 1/2	4 7/8	10 1/2	11 1/2	6 1/4
<b>600 Volts D-C. or A-C.</b>														
30	5	9	14	19	15	24	3/4	1/2	3/4	4 1/4	4 3/8	6 1/2	7 1/2	2 1/2
60	5	9	14	19	15	24	3/4	1/2	3/4	4 1/4	4 3/8	6 1/2	7 1/2	2 3/4
100	5	11	16	22	18	32	3/4	1/2	3/4	5 1/2	5	8 1/2	9	3 1/4
200	6	12	18	24	22	37	1	3/8	1	6	5 1/2	9 1/2	10 1/2	4 1/4
400	6	12	18	24	25	43	1	1/2	1 1/4	6	6	11 1/2	12 1/2	5 1/4
600	7	13	20	26	27	47	1 1/4	1/2	1 1/4	6 1/4	6 1/4	12	12 1/2	6 1/4

DIMENSIONS IN INCHES

Amp.	J		K	L	M	N	O	P	Q	R		T		U	V
	Hinge-Jaw Fused	Break-Jaw Fused								1, 2 & 3 Pole	4 Pole	1, 2 & 3 Pole	4 Pole		
<b>250 Volts D-C. or A-C.</b>															
30	1 1/2	1	2 3/4	.242-24	1 1/2	1 1/2	2 1/2	.242-24	2 5/8	2 5/8	4 1/2	4 1/2	...	...	
60	1 1/2	1 1/8	3	1 1/8-18	2 3/8	1 1/2	3 1/8	1 1/8-18	3	3 1/8	5 1/2	5 1/2	1 1/4	.259	
100	2 1/8	1 1/2	3 1/4	3/8-16	4 3/8	1 1/4	1 1/2	3 1/4	3 1/2	3 3/8	6 1/2	7 1/2	1 1/4	.384	
200	3 1/8	1 7/8	3 3/4	1/2-13	5 3/4	1 1/2	2 1/2	3 1/4	4 1/8	4 1/2	8 1/2	8 1/2	1 1/4	.558	
400	4 1/4	2 1/2	3 3/4	5/8-11	6 3/4	2 1/2	3	3 3/4	7 1/4	7 1/2	10 1/2	11 1/2	2 1/4	.9185	
600	4 7/8	2 3/4	4	3/4-16	8 3/8	2 1/2	3 1/2	4	7 1/2	8 1/4	11 1/2	12 1/2	3 1/2	1.28	
<b>500 Volts A-C.</b>															
30	1 1/2	1 1/8	3	1 1/8-18	4 1/2	1 1/2	2 1/2	.242-24	3	3 1/8	5 1/2	5 1/2	...	...	
60	1 1/2	1 1/8	3	1 1/8-18	4 7/8	1 1/2	3 1/8	1 1/8-18	3	3 1/8	5 1/2	5 1/2	1 1/4	.259	
100	2 1/8	1 1/2	3 1/4	3/8-16	6 3/8	1 1/4	1 1/2	3 1/4	3 1/2	3 3/8	6 1/2	7 1/2	1 1/4	.384	
200	3 1/8	1 7/8	3 3/4	1/2-13	8 1/4	1 1/2	2 1/2	3 1/4	4 1/8	4 1/2	8 1/2	8 1/2	1 1/4	.558	
400	4 1/4	2 1/2	3 3/4	5/8-11	9 3/4	2 1/2	3	3 3/4	7 1/4	7 1/2	10 1/2	11 1/2	2 1/4	.9185	
600	4 7/8	2 3/4	4	3/4-16	11 3/8	2 1/2	3 1/2	4	7 1/2	8 1/4	11 1/2	12 1/2	3 1/2	1.28	
<b>600 Volts D-C. or A-C.</b>															
30	1 1/2	1 1/8	3	1 1/8-18	4 1/2	1 1/2	2 1/2	.242-24	2 1/2	2 5/8	7 1/2	7 1/2	...	.259	
60	1 1/2	1 1/8	3	1 1/8-18	4 7/8	1 1/2	3 1/8	1 1/8-18	2 1/2	2 5/8	7 1/2	7 1/2	1 1/4	.259	
100	2 1/8	1 1/2	3 1/4	3/8-16	6 3/8	1 1/4	1 1/2	3 1/4	3 1/2	3 3/8	6 1/2	7 1/2	1 1/4	.384	
200	3 1/8	1 7/8	3 3/4	1/2-13	8 1/4	1 1/2	2 1/2	3 1/4	4 1/8	4 1/2	8 1/2	8 1/2	1 1/4	.558	
400	4 1/4	2 1/2	3 3/4	5/8-11	9 3/4	2 1/2	3	3 3/4	7 1/4	7 1/2	10 1/2	11 1/2	2 1/4	.9185	
600	4 7/8	2 3/4	4	3/4-16	11 3/8	2 1/2	3 1/2	4	7 1/2	7 3/4	12 1/2	13 1/2	3 1/2	1.28	

\*For single-pole double-throw switches, A=9 inches.

†For single-pole double-throw switches, A=7 inches.

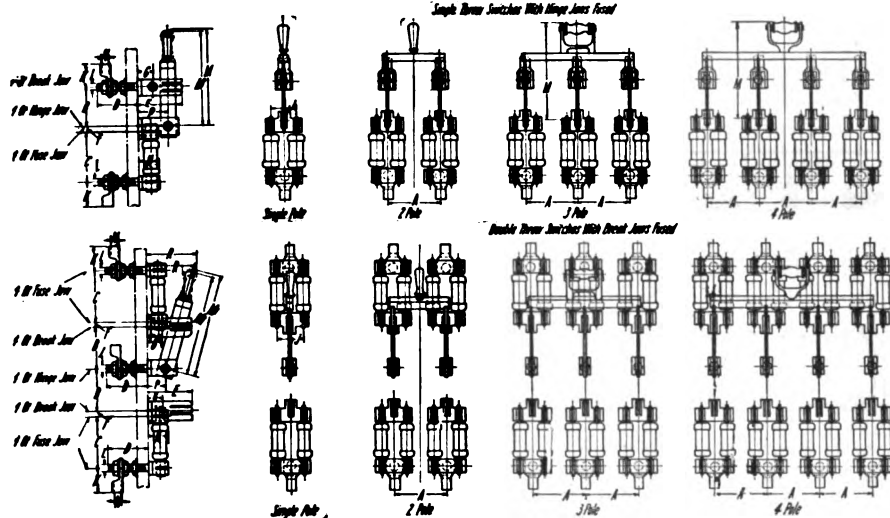
‡For single-pole double-throw switches, A=11 inches.

§Diameter in inches and number of threads to the inch.

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

KNIFE SWITCHES—Continued

TYPE A REAR-CONNECTED—FUSED

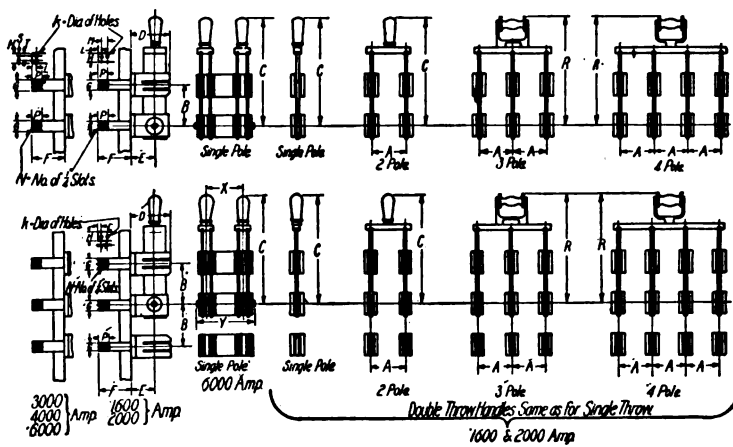


DIMENSIONS IN INCHES

Volts	Amp.	A	B	C	D	E		G				M		M'		N	P		R				
						Break Jaw	Break Jaw Fused	Break Jaw	Break Jaw Fused	H	J	K	L	S.P. & 2 P.	3 P. & 4 P.		S.P. & 2 P.	3 P. & 4 P.	Hinge Jaw Fused	Break Jaw Fused	1 & 2 P. Sw.	3 & 4 P. Sw.	
250 Volts D.C. & A.C.	800*	7 1/4	5 3/4	6 3/4	5 3/4	6 1/4	6 1/4	7/8	2 1/4	2 1/4	3 1/4	3 3/4	3 7/8	1	12 1/4	13 1/4	13 3/4	14 3/4	1.385	4 1/4	2 3/4	7 1/4	8 1/4
	1000*	7 3/8	6	8 1/8	5 3/4	6 3/4	6 3/4	7/8	2 1/2	2 1/2	3 1/2	3 3/4	4 1/8	1	13 3/4	14 3/4	14 3/4	15 1/4	1 3/4	4 3/4	3 3/4	7 3/4	7 3/4
	1200 D.C. 1100 A.C.*	7 7/8	6	8 1/8	5 3/4	7 1/4	7 1/4	7/8	2 3/8	2 3/8	3 3/8	3 3/4	4 1/8	1 1/4	13 3/4	14 3/4	14 3/4	15 1/4	1 3/4	4 3/4	3 3/4	8	8 1/4
500 Volt A.C.	800*	8 1/4	5 3/4	9 3/4	5 3/4	6 1/4	6 1/4	7/8	2 1/4	2 1/4	3 1/4	3 3/4	3 7/8	1	12 1/4	13 1/4	13 3/4	14 3/4	1.385	4 1/4	2 3/4	7 1/4	8 1/4
	1000*	9 1/8	6	11 1/8	5 3/4	6 1/4	6 1/4	7/8	2 1/2	2 1/2	3 1/2	3 3/4	4 1/8	1	13 3/4	14 3/4	14 3/4	15 1/4	1 3/4	4 3/4	3 3/4	7 3/4	7 3/4
	1100*	9 1/4	6	11 1/8	5 3/4	7 1/4	7 1/4	7/8	2 3/8	2 3/8	3 3/8	3 3/4	4 1/8	1 1/4	13 3/4	14 3/4	14 3/4	15 1/4	1 3/4	4 3/4	3 3/4	8	8 1/4

\*NOTE—Terminals are not included in style number and price of the 1000 and 1200-1100-ampere switches. On the 800-ampere switches, terminals are included on the break jaws only.

TYPE A REAR-CONNECTED WITH LAMINATED STUDS

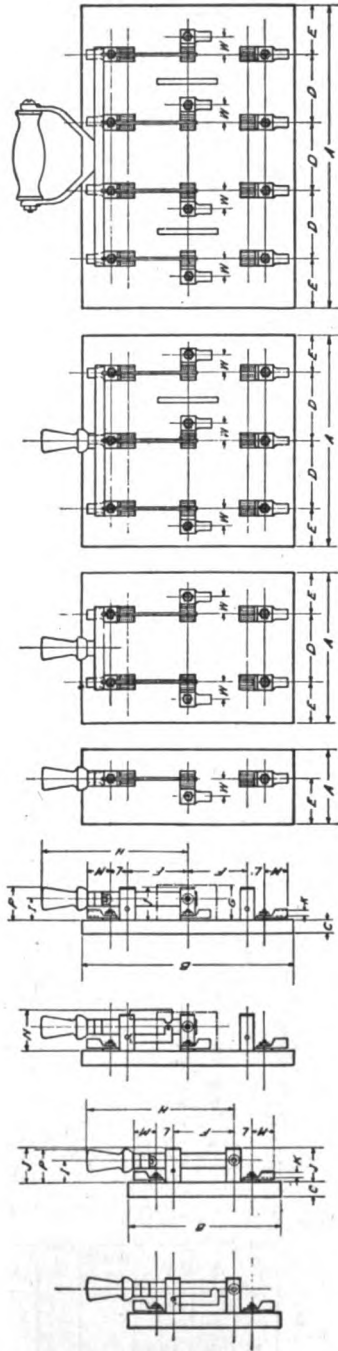


DIMENSIONS—INCHES

Volts	AMPS.		A	B	C	D	E	F	G	H	K	L	M	N	P	R	S	T	V	No. of Bl. per P.	X	Y
	D.C.	A.C.																				
250-V. D.C. 300-V. A.C.	1600	1200	5 1/4	6 1/4	15 1/4	6 1/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	2	1 1/4	16 1/4	...	...	...	...	...	...
	2000	1600	5 3/4	6 3/4	15 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	2	1 1/4	16 1/4	...	...	...	...	...	
	3000	2200	6 1/4	6 3/4	15 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	4	1 1/4	16 1/4	1 1/4	1 1/4	16 1/4	...	...	
	4000	2800	...	6 3/4	15 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	5	1 1/4	16 1/4	1 1/4	1 1/4	16 1/4	3	...	
	6000	4000	...	7 1/4	16 1/4	6 3/4	4 1/4	7	3 3/4	1 1/4	1 1/4	1 1/4	1 1/4	7	1 1/4	16 1/4	1 1/4	1 1/4	16 1/4	4	4 1/4	8 1/4
500-V. D.C. 600-V. A.C.	1600	1200	7	8 1/4	17 1/4	6 1/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	2	1 1/4	18 1/4	...	...	...	...	...	
	2000	1600	7 3/4	8 1/4	17 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	2	1 1/4	18 1/4	...	...	...	...		
	3000	2400	8 1/4	8 1/4	17 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	4	1 1/4	18 1/4	1 1/4	1 1/4	18 1/4	...	...	
	4000	2800	...	8 1/4	17 1/4	6 3/4	3 3/4	5 1/4	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4	5	1 1/4	18 1/4	1 1/4	1 1/4	18 1/4	3	...	
	6000	4000	...	8 1/4	17 1/4	6 3/4	4 1/4	7	3 3/4	1 1/4	1 1/4	1 1/4	1 1/4	7	1 1/4	18 1/4	1 1/4	1 1/4	18 1/4	4	4 1/4	8 1/4

KNIFE SWITCHES—Continued

TYPE C FRONT-CONNECTED—NOT FUSED



Throw	A			B		C			D	E			F	G	H		I	J	K	L	M	N	P		W
	S.P.	2 P.	3 P.	4 P.	S.P.	3 P.	4 P.	S.P.		2 P.	3 P.	4 P.			1, 2 and 3 P.	4 P.							1, 2 and 3 P.	4 P.	
30 S.T.	2½	4	6	9	4½	5	1½	5½	2½	1½	1½	2	1½	1½	4½	5½	¾	1½	...	...	...	...	1	1½	1½
30 D.T.	2½	5	7	10	7	7	1½	3½	2½	1½	1½	2	1½	1½	4½	5½	¾	1½	...	...	...	...	1	1½	1½
60 S.T.	2½	5	8	11	7	7	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	285	1½	1½	1½	1½	1½	1½
60 D.T.	2½	5½	8	11	8	8	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	285	1½	1½	1½	1½	1½	1½
100 S.T.	2½	6	10	14	11	10	1½	3½	3½	1½	1½	2½	1½	1½	6½	7½	1½	1½	398	1½	1½	1½	1½	1½	1½
100 D.T.	2½	6	10	14	11	10	1½	3½	3½	1½	1½	2½	1½	1½	6½	7½	1½	1½	398	1½	1½	1½	1½	1½	1½
200 S.T.	2½	8	12	16	14	14	1½	3½	3½	1½	1½	2½	1½	1½	8½	9½	1½	1½	559	1½	1½	1½	1½	1½	1½
200 D.T.	2½	8	12	16	14	14	1½	3½	3½	1½	1½	2½	1½	1½	8½	9½	1½	1½	559	1½	1½	1½	1½	1½	1½
30 S.T.	2½	5	8	11	7	7	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	...	...	...	...	1½	1½	1½
30 D.T.	2½	5	8	11	7	7	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	...	...	...	...	1½	1½	1½
60 S.T.	2½	5	8	11	7	7	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	285	1½	1½	1½	1½	1½	1½
60 D.T.	2½	5	8	11	7	7	1½	3½	3	1½	1½	2½	1½	1½	5½	6½	1	1½	285	1½	1½	1½	1½	1½	1½
100 S.T.	2½	5½	8	11	8	8	1½	3½	3½	1½	1½	2½	1½	1½	6½	7½	1½	1½	398	1½	1½	1½	1½	1½	1½
100 D.T.	2½	5½	8	11	8	8	1½	3½	3½	1½	1½	2½	1½	1½	6½	7½	1½	1½	398	1½	1½	1½	1½	1½	1½
200 S.T.	2½	6	10	14	11	10	1½	3½	3½	1½	1½	2½	1½	1½	8½	9½	1½	1½	559	1½	1½	1½	1½	1½	1½
200 D.T.	2½	6	10	14	11	10	1½	3½	3½	1½	1½	2½	1½	1½	8½	9½	1½	1½	559	1½	1½	1½	1½	1½	1½
30 S.T.	2½	7	11	20	8	8	1½	4½	4½	1½	1½	2½	1½	1½	7½	8½	1	1½	...	...	...	...	1½	1½	1½
30 D.T.	2½	7	11	20	8	8	1½	4½	4½	1½	1½	2½	1½	1½	7½	8½	1	1½	...	...	...	...	1½	1½	1½
60 S.T.	2½	7	11	20	8	8	1½	4½	4½	1½	1½	2½	1½	1½	7½	8½	1	1½	285	1½	1½	1½	1½	1½	1½
60 D.T.	2½	7	11	20	8	8	1½	4½	4½	1½	1½	2½	1½	1½	7½	8½	1	1½	285	1½	1½	1½	1½	1½	1½
100 S.T.	2½	8	14	20	11	10	1½	5½	5½	1½	1½	2½	1½	1½	8½	9½	1½	1½	398	1½	1½	1½	1½	1½	1½
100 D.T.	2½	8	14	20	11	10	1½	5½	5½	1½	1½	2½	1½	1½	8½	9½	1½	1½	398	1½	1½	1½	1½	1½	1½
200 S.T.	2½	10	16	24	12	12	1½	6½	6½	1½	1½	2½	1½	1½	10½	11½	1½	1½	559	1½	1½	1½	1½	1½	1½
200 D.T.	2½	10	16	24	12	12	1½	6½	6½	1½	1½	2½	1½	1½	10½	11½	1½	1½	559	1½	1½	1½	1½	1½	1½

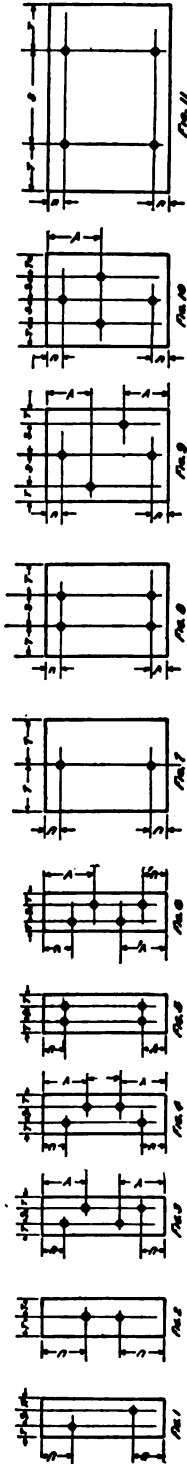
These dimensions are for reference only. For official dimensions apply to the nearest District Office.





KNIFE SWITCHES—Continued

TYPE C FRONT-CONNECTED—FUSED—MOUNTING-BOLT HOLES



Volts	Amps.	Throw	FIGURES				S.P.	S			T			U			V		U <sup>1</sup>	X *	Y *	Z *	V <sup>1</sup>
			S.P.	2 P.	3 P.	4 P.		S.P.	2 P.	3 P.	4 P.	S.P.	2 P.	3 and 4 P.	S.P.	2 P.							
30	S.T.	D.T.	1	9	11	4 1/2	1 1/2	2 1/2	3 1/2	4 1/2	5/8	2 1/2	2 1/2	1	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3/8	3/8	3/8	...
			2	8	11	4 1/2	1 1/2	2 1/2	3 1/2	4 1/2	5/8	2 1/2	2 1/2	1 1/2	2 1/2	2 1/2	2 1/2	2 1/2	2 1/2	3/8	3/8	3/8	...
	S.T.	D.T.	3	9	11	6	1 1/2	3	3	6	1 1/2	1 1/2	1 1/2	1 1/2	4	5 1/2	4	4	4	3/8	3/8	3/8	...
			4	8	11	6	1 1/2	3	3	6	1 1/2	1 1/2	1 1/2	1 1/2	4	5 1/2	4	4	4	3/8	3/8	3/8	...
60	S.T.	D.T.	5	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
			6	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
	S.T.	D.T.	7	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...
			8	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...
100	S.T.	D.T.	9	8	11	6	1 1/2	3	6	3/4	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
			10	8	11	6	1 1/2	3	6	3/4	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
	S.T.	D.T.	11	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
			12	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
200	S.T.	D.T.	13	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...
			14	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...
	S.T.	D.T.	15	8	11	6	1 1/2	3	6	3/4	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
			16	8	11	6	1 1/2	3	6	3/4	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
300	S.T.	D.T.	17	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
			18	8	11	6 1/2	1 1/2	3 1/2	6 1/2	7/8	2 1/2	2 1/2	2 1/2	2 1/2	4 1/2	5 1/2	4 1/2	4 1/2	4 1/2	3/8	3/8	3/8	...
	S.T.	D.T.	19	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...
			20	8	11	7 1/2	2	3 1/2	7 1/2	1	1 1/2	1 1/2	1 1/2	1 1/2	5 1/2	6 1/2	5 1/2	5 1/2	5 1/2	3/8	3/8	3/8	...

\*X = Drill; Y = Diam. of Counterbore; Z = Depth of Counterbore. These dimensions are for reference only. For official dimensions apply to the nearest District Office.





## APPLICATION DATA FOR FUSES AND KNIFE SWITCHES

### Fuses for Use With Direct-Current Motors, Based on 25% Overload

H. P. Rating	115 Volts, Motor Voltage		230 Volts, Motor Voltage		550 Volts, Motor Voltage	
	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.
1	37160	10	37157	5	37187	3
1½	37162	15	37159	8	37187	3
2	37163	20	37180	10	37189	5
2½	37164	25	37181	12	37190	6
3	37165	30	37162	15	37190	6
3½	37166	35	37163	20	37190	6
5	37169	50	37164	25	37192	10
6½	184111	65	37165	35	37194	15
7½	184112	70	37165	35	37194	15
8½	37172	85	37168	45	37195	20
10	184114	90	37168	45	37195	20
11	37173	100	184110	55	37196	25
12½	184116	110	37160	60	37196	25
15	37174	125	184112	70	37197	30
20	37176	175	184114	90	37198	35
25	37178	225	184116	110	37200	45
30	184118	275	37174	125	184125	55
35	.....	325	37175	150	184126	65
40	.....	350	37176	175	37203	75
50	.....	450	37178	225	184130	95
60	.....	550	.....	.....	184131	110
75	.....	.....	.....	.....	37207	150
100	.....	.....	.....	.....	37209	200

For other horse-power and voltage ratings, use size of fuses in proportion, i.e., for higher voltages use smaller ampere rating on fuses, etc.

### Fuses and Knife Switches for Use With Wound Rotor Induction Motors

H. P. Rating	SWITCH		FUSE		SWITCH		FUSE	
	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.
<b>Two-Phase Alternating-Current</b>								
<b>220 Volts, Motor Voltage</b>								
5	228370	30	37163	20	228410	30	37191	8
7½	228370	30	37164	25	228410	30	37194	15
10	228371	60	37166	35	228410	30	37195	20
15	228371	60	37168	45	228410	30	37196	25
20	228371	60	37170	60	228410	30	37197	30
25	228372	100	184112	70	228411	60	37198	35
30	228372	100	184114	90	228411	60	37200	45
35	228373	200	184116	110	228411	60	184125	55
40	228373	200	184117	120	228411	60	37202	60
50	228373	200	37175	150	228412	100	184127	70
<b>440 Volts, Motor Voltage</b>								
5	228366	30	37163	20	228406	30	37192	10
7½	228366	30	37165	30	228406	30	37194	15
10	228367	60	37167	40	228406	30	37195	20
15	228367	60	37169	50	228406	30	37196	25
20	228368	100	184112	70	228407	60	37198	35
25	228368	100	37172	85	228407	60	37199	40
30	228368	100	37173	100	228407	60	37201	50
35	228369	200	37174	125	228407	60	37202	60
40	228369	200	37175	150	228408	100	184127	70
50	228369	200	37176	175	228408	100	184128	80
<b>Three-Phase Alternating-Current</b>								
<b>220 Volts, Motor Voltage</b>								
5	228366	30	37163	20	228406	30	37192	10
7½	228366	30	37165	30	228406	30	37194	15
10	228367	60	37167	40	228406	30	37195	20
15	228367	60	37169	50	228406	30	37196	25
20	228368	100	184112	70	228407	60	37198	35
25	228368	100	37172	85	228407	60	37199	40
30	228368	100	37173	100	228407	60	37201	50
35	228369	200	37174	125	228407	60	37202	60
40	228369	200	37175	150	228408	100	184127	70
50	228369	200	37176	175	228408	100	184128	80
<b>440 Volts, Motor Voltage</b>								
5	228462	30	37191	8	228463	60	37198	35
7½	228462	30	37193	12	228463	60	37199	40
10	228462	30	37194	15	228463	60	37201	50
15	228462	30	37195	20	228463	60	37202	60
20	228462	30	37197	30	228464	100	184128	65

APPLICATION DATA FOR FUSES AND KNIFE SWITCHES—Continued

Fuses and Knife Switches for Use With Squirrel Cage Induction Motors

H. P. Rating	SWITCH		FUSE		SWITCH		FUSE	
	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.
<b>Two-Phase Alternating-Current</b>								
<b>110 Volts, Motor Voltage</b>								
1/2	228370	30	37180	10	228370	30	37158	6
1	228370	30	37183	20	228370	30	37160	10
2	228371	60	37186	35	228370	30	37162	15
3	228371	60	37188	45	228370	30	37164	25
5	228372	100	184113	80	228371	60	37167	40
<b>220 Volts, Motor Voltage</b>								
1/2	228410	30	37187	3	.....	...	.....	...
1	228410	30	37189	5	.....	...	.....	...
2	228410	30	37192	10	.....	...	.....	...
3	228410	30	37194	15	.....	...	.....	...
5	228410	30	37195	20	.....	...	.....	...
<b>440 Volts, Motor Voltage</b>								
1/2	228410	30	37187	3	.....	...	.....	...
1	228410	30	37189	5	.....	...	.....	...
2	228410	30	37192	10	.....	...	.....	...
3	228410	30	37194	15	.....	...	.....	...
5	228410	30	37195	20	.....	...	.....	...

Three-Phase Alternating-Current

H. P. Rating	SWITCH		FUSE		SWITCH		FUSE	
	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.
<b>110 Volts, Motor Voltage</b>								
1/2	228366	30	37161	12	228366	30	37158	6
1	228366	30	37163	20	228366	30	37160	10
2	228367	60	37166	35	228366	30	37163	20
3	228367	60	37169	50	228366	30	37165	30
5	228368	100	184114	90	228367	60	37168	45
<b>220 Volts, Motor Voltage</b>								
1/2	228406	30	37187	3	228462	30	37186	2
1	228406	30	37189	5	228462	30	37188	4
2	228406	30	37192	10	228462	30	37191	8
3	228406	30	37194	15	228462	30	37193	12
5	228406	30	37195	25	228462	30	37195	20
<b>440 Volts, Motor Voltage</b>								
1/2	228406	30	37187	3	228462	30	37186	2
1	228406	30	37189	5	228462	30	37188	4
2	228406	30	37192	10	228462	30	37191	8
3	228406	30	37194	15	228462	30	37193	12
5	228406	30	37195	25	228462	30	37195	20

Fuses and Knife Switches for Use With Type AR Induction Motors

Single-Phase Alternating-Current

H. P. Rating	SWITCH		FUSE		SWITCH		FUSE	
	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.	Style No.	Amps.
<b>WITHOUT RHEOSTAT</b>								
<b>110 Volts, Motor Voltage</b>								
2	228364	100	184113	80	228363	60	37167	40
3	228365	200	184117	120	228363	60	37170	60
5	228365	200	37177	200	228364	100	37173	100
7 1/2	227985	400	184119	325	228365	200	37176	175
10	227985	400	37182	400	228365	200	37177	200
<b>220 Volts, Motor Voltage</b>								
1/2	228362	30	37163	20	228362	30	37160	10
3/4	228362	30	37165	30	228362	30	37162	15
1	228363	60	37167	40	228362	30	37163	20
<b>WITH RHEOSTAT</b>								
2	228363	60	37167	40	228362	30	37163	20
3	228363	60	37170	60	228362	30	37165	30
5	228364	100	37173	100	228363	60	184110	55
7 1/2	228365	200	37176	175	228364	100	184113	80
10	228365	200	37170	200	228364	100	37173	100
<b>Fuses for Four Times Full-Load Current</b>								
1/2	228362	30	37163	20	228362	30	37160	10
3/4	228362	30	37165	30	228362	30	37162	15
1	228363	60	37167	40	228362	30	37163	20
<b>Fuses for Twice Full-Load Current</b>								
1/2	228362	30	37160	10	228362	30	37158	6
3/4	228362	30	37162	15	228362	30	37159	8
1	228362	30	37163	20	228362	30	37160	10

## FUSE BLOCKS AND FUSE HOLDERS

### FOR ENCLOSED CARTRIDGE FUSES

For Voltages up to 600

Front and Rear Connected

These fuse blocks are used for mounting on the wall or on switchboard panels. The fuse blocks are of a rugged and substantial construction, but, at the same time, present a neat and pleasing appearance, enabling them to match in appearance other apparatus with which they may be mounted.

**Ratings**—The fuse blocks as listed are rated according to the ampere and voltage capacities of standard cartridge fuses with which they are designed to be used, and the ratings apply to either direct or alternating current.

**Approval**—All of the 250-volt and the 600-volt fuse blocks up to and including 600 amperes conform to the requirements of the National Electrical Code and are included in the List of Approved Fittings issued by the National Board of Fire Underwriters.

**Fuses**—The fuses for use with these blocks are listed on pages on "Enclosed Cartridge Fuses."

**Dimensions**—The 250-volt and 600-volt fuse blocks have the National Electrical Code Standard dimensions and will receive any cartridge fuses of corresponding ampere capacities conforming thereto.

**Shipment**—The number of fuse blocks and fuse holders included in a standard package and the net weight of each are given opposite each style number.



FIG. 1—30-AMPERE FRONT-CONNECTED FUSE BLOCK



FIG. 2—100-AMPERE FRONT-CONNECTED FUSE BLOCK

**Instructions for Ordering**—Whenever possible, fuse blocks and fuse holders should be ordered in standard package quantities. Standard package quantities cannot be made up by combining different capacities.

### FUSE BLOCKS WITH INSULATING BASES

**Single-Pole Front-Connected**—Single-pole front-connected blocks are listed for use with the standard cartridge fuses for voltages up to 600.

200-ampere, 250-volt fuse blocks have either porcelain or slate bases; while all other 250-volt and 600-volt fuse blocks have slate bases.

**Contacts**—The fuse blocks of capacities up to and including 60 amperes have ferrule contacts, and those of greater capacity have knife-blade contacts.

The contacts are securely fastened to the bases so as to prevent any possibility of turning or getting out of alignment.

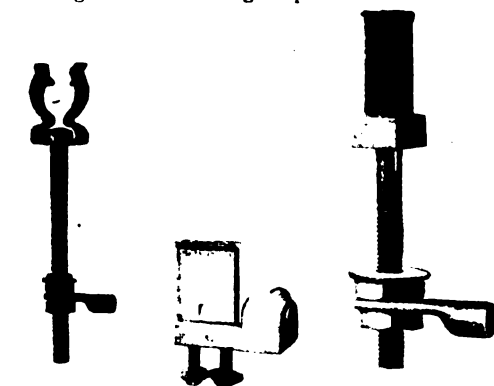
**Connections** to fuse blocks of 30 amperes capacity are made by means of a screw and washer. For larger capacities the fuse holders are equipped with terminal lugs into which the connecting wires must be soldered.

#### Fuse Holders Without Bases

Fuse holders are listed for mounting directly on the panels or other insulating support, bases not being supplied.

**Front-connected** fuse holders are the same as those supplied on the "fuse blocks with insulating bases" described above. Small screws are supplied for mounting on blocks.

**Rear-connected** fuse holders are similar to the front-connected except that they are supplied with studs, terminal lugs, and clamping nuts.



Rear-Connected 1-60 Amperes      Front-Connected 65-600 Amperes      Rear-Connected 65-600 Amperes  
FIG. 3—FUSE HOLDERS WITHOUT BASES

**Rear-connected**—As the switchboard panel is generally the only place on which it is desired to mount rear-connected fuse holders, these are not listed with bases. (See "Fuse Holders".)

**Bases**—The 250-volt and 600-volt fuse blocks up to and including 60-ampere capacity have porcelain bases; the single-pole 100-ampere and

FUSE BLOCKS AND FUSE HOLDERS—Continued

PRICES—FUSE BLOCKS WITH INSULATING BASES

Single-Pole Front-Connected

Style number and list price include insulating base and fuse holders with terminal lug details but without fuse.

Capacity Range Amperes	Base	Contacts	Approx Net *Weight Lb.	APPROX. DIMENSIONS, INCHES			Ht. over Base and Contacts	Standard Package Quantity	Style No.	List Price Each
				Length	Width	Height				
<b>For Voltages up to 250</b>										
1 - 30	Porcelain	Ferrule	3/4	5 1/2	1 1/2	3/8	1 3/4	50	32481	\$0 80
1 - 30	Slate	Ferrule	3/4	5 1/2	1 1/2	3/8	1 3/4	50	300424	80
35 - 60	Porcelain	Ferrule	3/4	5 1/2	1 1/2	3/8	2 1/4	50	32482	1 30
35 - 60	Slate	Ferrule	3/4	5 1/2	1 1/2	3/8	2 1/4	50	300425	1 30
65 -100	Porcelain	Knife	1 1/4	7 1/2	2	1/2	2 1/2	50	124397	2 80
65 -100	Slate	Knife	2	7 1/2	2	1/2	2 1/2	50	124398	2 80
110 -200	Porcelain	Knife	2 1/2	9 1/2	2 1/4	1	2 1/2	50	124398	5 50
110 -200	Slate	Knife	3 1/2	9 1/2	2 1/4	1	2 1/2	50	124390	5 50
225 -400	Slate	Knife	6	11 3/4	3	1	3 1/2	25	124391	10 50
450 -600	Slate	Knife	10 1/4	14	3 1/2	1 1/4	4 1/2	10	124392	14 40
<b>For Voltages up to 600</b>										
1 - 30	Porcelain	Ferrule	3/4	7	1 1/2	3/8	2 1/4	50	32485	1 20
35 - 60	Porcelain	Ferrule	1	7 1/2	1 1/2	3/8	2 1/4	50	32486	1 80
65 -100	Slate	Knife	2 1/2	9 1/2	2	1/2	2 1/4	50	124393	2 50
110 -200	Slate	Knife	6	12 1/2	2 1/4	1	2 1/2	50	124394	6 00
225 -400	Slate	Knife	9	14 1/2	3	1	3 1/2	25	124395	12 00
450 -600	Slate	Knife	12	17	3 1/2	1 1/4	4 1/2	10	124396	15 60

\*For shipping weight add 10 per cent for boxing.

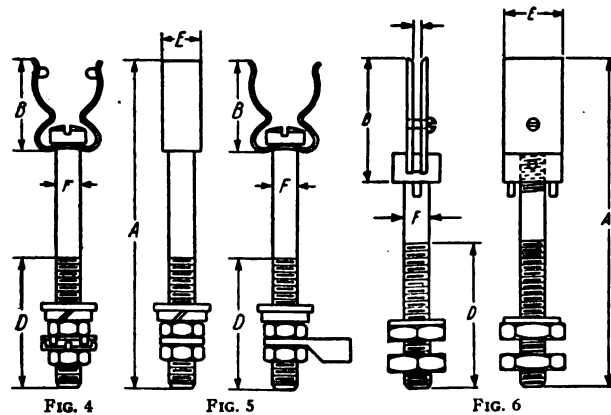
PRICES—FUSE HOLDERS WITHOUT BASES

Style number and list price include one fuse holder complete with connecting terminals (two are required for a complete block). The front-connected include mounting screws of proper length for the standard fuse blocks listed. The rear-connected include terminal lug and clamping nuts. The studs are of sufficient length for mounting on panels 1 to 2 inches thick.

Capacity Range Amperes	Maximum Voltage	Standard Package	FRONT-CONNECTED			REAR-CONNECTED			List Price Each
			Approx. Net *Wt. Lb.	Style No.	List Price Each	Approx. Net *Wt. Lb.	For 1-, 1 1/4-, or 1 1/2-inch Panel	For 2-Inch Panel	
1 - 30	250	100	1/2	32488	\$0 40	1/2	229235	229228	\$0 50
1 - 30	600	100	1/2	32492	45	1/2	229237	229230	60
1 1/2 - 15	2500-3500	100	1/2	32499	85	1/2	229239	229232	85
20 - 30	2500-3500	100	1/2	32489	85	1/2	229236	229229	90
35 - 60	250	100	1/2	32493	70	1/2	229238	229231	95
35 - 60	600	100	1/2	124403	1 00	1 1/4	289464	289464	1 60
65 -100	250 to 3500	100	1/2	124404	1 60	1 1/4	289465	289465	2 40
110 -200	250 to 2500	100	1/2	124403	1 60	1 1/4	289465	289465	2 40
125 -150	3500	50	1 1/4	124405	3 80	2 1/2	289466	289466	5 60
225 -400	250-600	20	2	124406	5 00	5	289467	289467	8 00
450 -600	250-600	20	2	124406	5 00	5	289467	289467	8 00

Fuse blocks and fuse holders should be ordered in standard package quantities whenever possible. Standard package quantities cannot be made up by combining different capacities. \*For shipping weight add 10 per cent for boxing.

Order by Style Number



OUTLINE DIMENSIONS  
Fuse Holders Without Bases

Style No.	Fig.	DIMENSIONS IN INCHES					
		A	B	C	D	E	F
229228	4	3 1/2	1 1/2	..	1 1/2	1/2	1/4
229229	5	3 3/4	1 1/2	..	1 1/2	1/2	1/4
229230	4	3 3/4	1 1/2	..	1 1/2	1/2	1/4
229231	5	4	1 1/2	..	1 1/2	1/2	1/4
229232	5	4	1 1/2	..	1 1/2	1/2	1/4
229235	4	3	1 1/2	..	1 1/2	1/2	1/4
229236	5	3 1/4	1 1/2	..	1 1/2	1/2	1/4
229237	4	3 1/4	1 1/2	..	1 1/2	1/2	1/4
229238	5	3 1/2	1 1/2	..	1 1/2	1/2	1/4
229239	5	3 1/2	1 1/2	..	1 1/2	1/2	1/4
289464	6	4 1/2	1 1/2	1/2	2 1/2	1/2	1/4
289465	6	5 1/2	2 1/2	1/2	2 1/2	1 1/4	1/4
289466	6	6 1/4	3	1/2	3	1 1/4	1/4
289467	6	7 1/2	3 1/2	1/2	3 1/2	2 1/2	1/4

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

## FUSE WIRE AND FUSE RIBBON

The fuse wire listed in the following tables should be used with high voltage fused circuit-breakers and expulsion-type fuse blocks listed on pages of this catalogue under "Wiring Devices" and "High Tension Fuses and Miscellaneous Switches." When aluminum and nickel-silver wire, enclosed in a fibre tube, becomes red hot, but does not blow, there is a tendency to char the inner portion of the tube and to gradually destroy the tube. To prevent this action the portion of the wire within the tube should be inclosed in

asbestos sleeving (listed in this catalogue under "Insulating Materials"). The correct size of sleeving to use is one with  $\frac{3}{8}$ -inch inside diameter and  $\frac{1}{2}$ -inch outside diameter. It takes approximately 188 feet of this size tubing to make one pound net weight. Asbestos sleeving is used primarily to prolong the life of the fibre tube. If it cannot be obtained, the fuse wire may be used temporarily with out it.

### ALUMINUM WIRE

B. & S. Gauge	Diam. in Inches	Continuous Carrying Capacity, Amperes	Approx. No. of Feet Per Lb.	Net Wt. of Stand. Package (Spools), Lb.	List Price Per Lb.	B. & S. Gauge	Diam. in Inches	Continuous Carrying Capacity, Amperes	Approx. No. of Feet Per Lb.	Net Wt. of Stand. Package (Spools), Lb.	List Price Per Lb.
11	.0907	81	135	1	\$1 75	18	.0403	30	688	1	\$2 45
12	.0908	72	165	1	1 75	19	.0359	26	835	1	2 65
13	.0720	63	208	1	1 80	20	.0320	22	1050	1	2 90
14	.0641	54	264	1	1 85	21	.0285	18	1350	1	3 20
15	.0571	47	332	1	1 95	22	.0254	15	1680	1	3 70
16	.0508	40	420	1	2 15	23	.0226	12	2150	1	4 20
17	.0453	35	528	1	2 30	24	.0201	10	2670	1 1/2	5 00

### NICKEL-SILVER WIRE (18 per cent)

B. & S. Gauge	Continuous Carrying Capacity, Amperes	Approx. No. of Feet Per Lb.	Net Weight of Standard Package (Spools), Lb.	List Price Per Lb.	B. & S. Gauge	Continuous Carrying Capacity, Amperes	Approx. No. of Feet Per Lb.	Net Weight of Standard Package (Spools), Lb.	List Price Per Lb.
26	3.75	1300	1/2	\$1 80	36	0.50	13217	1/4	\$3 40
30	1.13	3288	1/2	2 00					

### ALLOY FUSE WIRE

Continuous Carrying Capacity Amperes	BEST LENGTHS FOR USE AND FUSING CURRENTS FOR SUCH LENGTHS		Approx. No. of Feet Per Lb.	Quantity on Spool, Lb.	List Price Per Lb.	Continuous Carrying Capacity Amperes	BEST LENGTHS FOR USE AND FUSING CURRENTS FOR SUCH LENGTHS		Approx. No. of Feet Per Lb.	Quantity on Spool, Lbs.	List Price Per Lb.
	Inches	Amperes					Inches	Amperes			
1	1 1/4	3 1/4	1021	1/4	\$4 00	18	2 1/2	25	44	1	\$2 00
2	1 1/2	5 1/2	419	1/2	3 50	20	2 1/2	28	39	1	1 50
3	1 3/4	7 1/2	273	1/2	3 00	25	2 3/4	34	29	1	1 50
4	1 3/4	9	213	1	2 25	30	2 3/4	40	24	1	1 50
5	1 3/4	10	173	1	2 25	35	3	43	20	1	1 50
6	2	11	148	1	2 25	40	3	48	18	1	1 50
7	2	12	124	1	2 25	45	3	54	16	1	1 50
8	2	14	109	1	2 25	50	3	59	14	1	1 50
9	2	15	97	1	2 25	60	3 1/4	70	10.5	5	1 50
10	2 1/4	16	80	1	2 00	70	3 1/4	78	9	5	1 50
12	2 1/4	18	70	1	2 00	75	3 1/4	85	8	5	1 50
14	2 1/4	20	60	1	2 00	80	3 1/4	92	7.5	5	1 50
15	2 1/4	22	57	1	2 00	90	3 1/2	108	6	5	1 50
16	2 1/2	23	51	1	2 00	100	4	114	5	5	1 50

Standard package, 25 lbs.

### ALLOY FUSE RIBBON

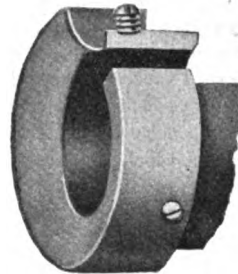
Safe Carrying Capacity Amperes	Width of Strip Inches	Approx. Fusing Current for Strips 2 1/2 Inches Long		Weight per Foot Oz.	List Price Per Pound	Safe Carrying Capacity Amperes	Width of Strip Inches	Approx. Fusing Current for Strips 2 1/2 Inches Long		Weight per Foot Oz.	List Price Per Pound
		Inches	Amperes					Inches	Amperes		
50	5/8	69	1	1	\$1 50	200	1	243	4 1/2	4 1/2	\$1 50
60	5/8	81	1 1/4	1 1/4	1 50	225	1	270	5 1/4	5 1/4	1 50
70	5/8	93	1 3/8	1 3/8	1 50	250	1	298	5 3/4	5 3/4	1 50
75	5/8	99	1 3/8	1 3/8	1 50	275	1	325	6 3/8	6 3/8	1 50
80	5/8	106	1 3/8	1 3/8	1 50	300	1	351	7	7	1 50
90	5/8	118	2	2	1 50	350	1	402	8 1/4	8 1/4	1 50
100	1	129	2 1/4	2 1/4	1 50	400	1	450	9 5/8	9 5/8	1 50
125	1	158	2 3/4	2 3/4	1 50	450	1	500	11 1/4	11 1/4	1 50
150	1	187	3 1/4	3 1/4	1 50	500	1	550	12 3/8	12 3/8	1 50
175	1	215	3 3/4	3 3/4	1 50	600	1	675	16	16	1 50

Packed in 5-pound tin boxes. Standard package, 25 lbs.

## PORCELAIN-LINED CONDUIT BUSHINGS



THREADED BUSHING



SET SCREW BUSHING

Westinghouse bushings are made of annealed cast iron and are designed to provide a durable, hard, and smooth surface for conduit outlets.

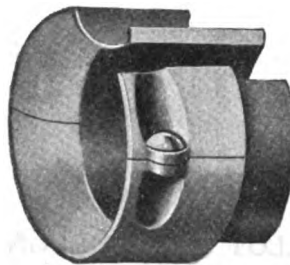
Porcelain lining is a very high insulator and the best and surest rust preventive known. It forms an insulating coating which is absolutely moisture-proof, is not affected by chemicals and acids, and withstands exceedingly high temperature without any harm.

Westinghouse porcelain lined set screw bushings are a great convenience where it is found difficult to place a thread on the conduit. In many cases it is

impossible to do so; for instance, where elbows are used as terminating points it is impossible to thread the elbows. Here the set screw bushings come in handy; all that is necessary is to countersink the conduit for the point of the set screw, place the bushing over the pipe, and then tighten the screws.

Westinghouse porcelain lined split bushings are designed to be used on conduits where it is impractical to thread the conduits or use set screw bushings. For instance, in rewiring buildings using existing conduits, the split bushing makes it unnecessary to disconnect the wire.

Standard Package	Size of Conduit, In.	THREADED		SET SCREW		SPLIT BUSHING	
		Style No.	List Price Per 100	Style No.	List Price Per 100	Style No.	List Price Per 100
100	1/2	K-2751	\$60 00	K-2681	\$42 00	K-2741	\$69 00
100	3/4	K-2752	64 00	K-2682	46 00	K-2742	70 00
60	1	K-2753	88 00	K-2683	58 00	K-2743	88 00
60	1 1/4	K-2754	102 00	K-2684	64 00	K-2744	102 00
50	1 1/2	K-2755	111 00	K-2685	76 00	K-2745	111 00
20	2	K-2756	127 00	K-2686	88 00	K-2746	127 00
20	2 1/2	K-2757	172 00	K-2687	124 00	K-2747	172 00
20	3	K-2758	210 00	K-2688	153 00	K-2748	210 00
10	3 1/2	K-2759	255 00	K-2689	184 00	K-2749	255 00
10	4	K-2760	292 00	K-2690	226 00	.....	.....



SPLIT BUSHING

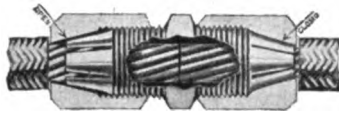
Order by Style Number

# WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS

## GENERAL

Westinghouse-Frankel solderless connectors constitute a complete line of connectors for splicing either stranded or solid wire, without the use of solder. Their application makes possible a perfect mechanical and electrical joint, and at the same time provides a saving in labor and time. Westinghouse-Frankel connectors will not heat as much on overload as the cables which they connect.

**Construction**—In the construction of Westinghouse-Frankel connectors a minimum number of parts has been used. For example, the two-way connector illustrated is composed of only three parts, consisting of a center fitting (A) with slotted jaws and two compression nuts (B).

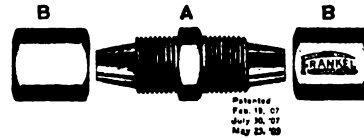


**Instructions for Making a Splice**—To make a splice with a two-way Westinghouse-Frankel connector, remove the insulation from the ends of the cable or wire for a distance equal to half the length of the connector and insert the bared ends in the fitting A so that they meet at the center, after which screw up the compression nuts B. The nuts

are so constructed that they force the jaws or slotted part of the fitting inwards causing it to grip the conductor firmly and thus form a perfect joint.

Splices with the other connectors are made in the same manner as with the two-way.

**Finish**—Westinghouse-Frankel connectors have a



plain or polished finish only. For finish in any of the following colors, namely, nickel, copper bronze, copper oxidized, or satin bronze, add 25% to the list price of the polished connectors. When finish is not specified on an order plain finish will always be furnished.

**Approval**—Westinghouse-Frankel connectors have been approved by the National Board of Fire Underwriters. In a burnout test with No. 1 stranded cable, in which the current was gradually increased until failure occurred, the circuit was opened by the melting of the solder from a soldered lug at 550 amperes. The test was completed without serious injury to the solderless connector.

## INSTRUCTIONS FOR ORDERING

Westinghouse-Frankel connectors when ordered for standard sizes of wire or cable are furnished for wire or cable of the diameter indicated opposite the standard B. and S. gauge numbers or circular mil sizes in the following table.

Where concentric stranded cables are used, it is preferable to measure their diameter and pick a standard connector from this table accordingly. Where there is any doubt as to the proper connector to use for a special diameter of cable the order should be entered giving the diameter of the cable with a full description of the connector wanted, or a sample of the cable should be sent with the order.

Where flexible conductors are used, the diameter

must be given or a sample of the conductor sent with the order.

Where rope laid cable is used, this must be specified in addition to giving the diameter and other information if the proper connector is to be obtained.

In sizes from 0000 wire down, connectors are furnished for either stranded cable or solid wire. It is, therefore, necessary to specify whether stranded or solid in giving the gauge number when ordering connectors of these sizes.

For two-way connectors and cable taps use Westinghouse style numbers where possible, as these cover connectors ordinarily carried in stock.

## DIAMETER OF STRANDED CABLE AND SOLID WIRE

STRANDED CABLE				SOLID WIRE			
No. B. and S. Gauge or Circular Mils	Diameter in Inches	No. B. and S. Gauge or Circular Mils	Diameter in Inches	No. B. and S. Gauge or Circular Mils	Diameter in Inches	No. B. and S. Gauge	Diameter in Inches
14	.073	200,000	.515	1,150,000	1.236	18	.040
12	.092	250,000	.575	1,200,000	1.263	16	.050
10	.115	300,000	.630	1,250,000	1.289	14	.064
9	.130	350,000	.680	1,300,000	1.315	12	.081
8	.145	400,000	.727	1,350,000	1.340	10	.102
7	.164	450,000	.772	1,400,000	1.364	9	.115
6	.184	500,000	.815	1,450,000	1.388	8	.128
5	.206	550,000	.854	1,500,000	1.412	7	.144
4	.231	600,000	.892	1,550,000	1.436	6	.162
3	.260	650,000	.929	1,600,000	1.459	5	.182
2	.293	700,000	.964	1,650,000	1.482	4	.204
1	.332	750,000	.997	1,700,000	1.504	3	.229
0	.375	800,000	1.031	1,750,000	1.526	2	.258
00	.420	850,000	1.062	1,800,000	1.548	1	.289
000	.472	900,000	1.093	1,850,000	1.569	0	.325
0000	.528	950,000	1.122	1,900,000	1.590	00	.365
80,000	.325	1,000,000	1.152	1,950,000	1.611	000	.410
100,000	.363	1,050,000	1.181	2,000,000	1.632	0000	.460
150,000	.444	1,100,000	1.209	2,500,000	1.850		

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

Approximate Gross Weight in Pounds per One Hundred Connectors

No. B. & S. Gauge or Circular Mils	2560 Two-Way	2586 Reducer	2561 Three-Way	2562 Elbow	2563 Plug Stub	2566 Service Box Plug	2564 Stud	2565 Ground Device	2568 Front Lug	2569 Back Lug 2570 Angle Lug 2571 Angle Lug 2572 Right Angle Lug 2573 Right Angle Lug	2574 Swivel Lug	2575 Cable Tap	2578, 2579 Binding Posts	No. B. & S. Gauge or Circular Mils	2567 Service Box Lugs	2580, 2581, 2582 Terminal Lugs
18																
16																
14	4	4	7	5	5	5	5	5	6	5	10	8	3	14	5	
12	4	4	8	5	5	5	5	5	6	6	10	8	3	12	6	
10	4	4	8	5	5	5	5	5	6	6	12	8	3	10	4	
8	5	5	9	6	6	6	6	6	8	8	16	9	4	8	7	5
7	5	5	9	6	6	6	6	6	8	8	16	10		7	8	
6	5	5	10	6	6	6	6	6	9	9	18	12		6	7	
5	6	6	12	8	8	8	8	8	10	10	20	15		5	9	
4	7	7	14	12	9	8	9	9	14	14	28	20		4	12	
3	8	8	28	16	12	12	12	12	15	15	30	22		3	13	
2	12	12	32	22	15	14	15	14	16	16	32	25		2	14	
1	14	14	40	24	20	18	20	18	18	18	36	32		1	16	
0	20	20	45	28	22	20	22	20	20	20	40	35		0	18	
00	30	30	55	35	24	22	24	22	26	28	56	50		00	24	
000	40	40	68	52	32	30	32	30	30	32	64	55		000	28	
0000	50	50	75	62	48	40	48	40	40	48	96	80		0000	35	
80000	14	14	22	24	20	20	20	18	18	18	36	32				
100000	20	20	30	28	23	23	23	20	20	20	40	35				
150000	35	35	53	48	25	25	25	20	30	30	60	55				
200000	50	50	80	50	48	48	48	40	40	40	80	80				
250000	65	65	90	80	62	62	62	60	60	60	120	120				
300000	95	95	120	100	70	70	70	75	75	75	150	155				
350000	100	100	150	115	80	80	80	80	85	85	170	140				
400000	110	110	170	125	90	90	90	85	95	95	190	145				
450000	120	120	200	160	100	100	100	90	100	100	200	175				
500000	130	130	250	200	110	110	110	120	130	130	260	225				
550000	140	140	260	210	130	130	130	125	130	130	260	235				
600000	155	155	270	220	160	160	160	130	140	140	280	250				
650000	160	160	280	230	180	180	180	140	150	150	300	280				
700000	185	185	290	240	200	200	200	150	165	165	330	310				
750000	200	200	300	250	225	225	225	170	180	180	360	350				
800000	220	220	320	270	250	250	250	190	220	220	440	500				
850000	240	240	360	290	260	260	260	220	250	250	500	525				
900000	275	275	390	310	270	270	270	240	265	265	530	550				
950000	325	325	420	340	280	285	285	260	270	270	540	600				
1000000	340	340	500	360	300	300	300	300	310	310	620	625				
1050000	350	350	550	380	315	315	315	315	320	320	640	650				
1100000	400	400	600	440	330	330	330	330	335	335	670	675				
1150000	450	450	650	470	345	345	345	345	350	350	700	700				
1200000	500	500	700	550	360	360	360	360	365	365	730	725				
1250000	515	515	725	580	375	375	375	375	385	385	770	750				
1300000	525	525	750	600	390	390	390	390	400	400	800	775				
1350000	535	535	775	610	410	410	410	400	410	410	820	800				
1400000	540	540	800	620	420	420	420	410	420	420	840	825				
1450000	550	550	825	630	430	430	430	420	430	430	860	850				
1500000	560	560	850	640	440	440	440	430	440	440	880	875				
1550000	570	570	875	650	450	450	450	440	450	450	900	900				
1600000	600	600	900	660	470	470	470	450	460	460	920	925				
1650000	650	650	925	680	490	490	490	470	470	470	940	950				
1700000	675	675	950	700	510	510	510	490	490	490	980	975				
1750000	700	700	955	750	530	530	530	510	510	510	1020	1000				
1800000	750	750	1000	790	550	550	550	540	540	540	1080	1050				
1850000	775	775	1100	800	570	570	570	580	580	580	1160	1100				
1900000	800	800	1200	850	590	590	590	650	650	650	1300	1200				
1950000	850	850	1350	900	610	610	610	750	700	700	1400	1350				
2000000	900	900	1450	960	625	625	625	825	825	825	1650	1450				
2500000	1000	1000	1500	1050	700	700	700	900	900	900	1800	1500				

Westinghouse-Frankel Solderless Connectors are:

- Approved by the National Board of Fire Underwriters.
- Installed in less time than soldered joints.
- Not endangered by overheating.
- Not loosened by expansion and contraction.
- More efficient than soldered joints in every way.



WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

TWO-WAY CONNECTORS

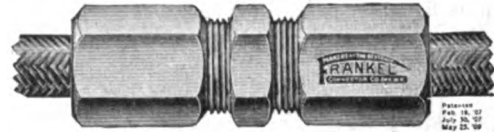
Frankel No. 2560

Two-way connectors are used to splice two conductors of the same size end to end. For splicing conductors of different sizes see "Reducers."

Style number includes complete terminal drilled for wire or cable, as stated in the table. Style number and list price cover connector with plain finish only. When ordering connectors with polished finish add 25 per cent to list prices given below.

Connectors differing from the standard listed style numbers should be specified "Two-way con-

nectors, FRANKEL STYLE No. 2560..... finish, for.....(giving number or size of solid wire or stranded cable.)"



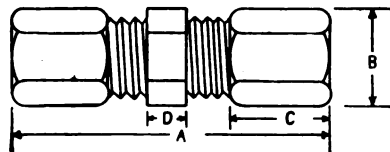
A NEAT, QUICK AND EFFECTIVE SPLICE

Size of Wire or Cable*	Style No.	List Price Plain Finish	Size of Wire or Cable*	Style No.	List Price Plain Finish
No. 14 Stranded	278015	\$0 35	1,100,000 C. M. Stranded	278052	\$5 50
No. 12 Stranded	278016	35	1,150,000 C. M. Stranded	278053	5 65
No. 10 Stranded	278017	35	1,200,000 C. M. Stranded	278054	5 75
No. 9 Stranded	278018	35	1,250,000 C. M. Stranded	278055	6 00
No. 8 Stranded	278019	35	1,300,000 C. M. Stranded	278056	6 25
No. 7 Stranded	278020	35	1,350,000 C. M. Stranded	278057	6 65
No. 6 Stranded	278021	35	1,400,000 C. M. Stranded	278058	7 00
No. 5 Stranded	278022	40	1,450,000 C. M. Stranded	278059	7 40
No. 4 Stranded	278023	40	1,500,000 C. M. Stranded	278060	7 75
No. 3 Stranded	278024	40	1,550,000 C. M. Stranded	278061	8 15
No. 2 Stranded	278025	45	1,600,000 C. M. Stranded	278062	8 50
No. 1 Stranded	278026	50	1,650,000 C. M. Stranded	278063	8 90
No. 0 Stranded	278027	60	1,700,000 C. M. Stranded	278064	9 25
No. 00 Stranded	278028	75	1,750,000 C. M. Stranded	278065	9 65
No. 000 Stranded	278029	90	1,800,000 C. M. Stranded	278066	10 00
No. 0000 Stranded	278030	1 10			
80,000 C. M. Stranded	278031	50	1,850,000 C. M. Stranded	278067	10 40
100,000 C. M. Stranded	278032	60	1,900,000 C. M. Stranded	278068	10 75
150,000 C. M. Stranded	278033	80	1,950,000 C. M. Stranded	278069	11 15
200,000 C. M. Stranded	278034	1 05	2,000,000 C. M. Stranded	278070	11 50
250,000 C. M. Stranded	278035	1 30	2,500,000 C. M. Stranded	278071	12 25
300,000 C. M. Stranded	278036	1 50	No. 18 Solid	278072	35
350,000 C. M. Stranded	278037	1 75	No. 16 Solid	278073	35
400,000 C. M. Stranded	278038	2 00	No. 14 Solid	278074	35
450,000 C. M. Stranded	278039	2 25	No. 12 Solid	278075	35
500,000 C. M. Stranded	278040	2 60	No. 10 Solid	278076	35
550,000 C. M. Stranded	278041	2 90	No. 9 Solid	278077	35
600,000 C. M. Stranded	278042	3 25	No. 8 Solid	278078	35
650,000 C. M. Stranded	278043	3 50	No. 7 Solid	278079	35
700,000 C. M. Stranded	278044	3 75	No. 6 Solid	278080	35
750,000 C. M. Stranded	278045	4 00	No. 5 Solid	278081	40
800,000 C. M. Stranded	278046	4 25	No. 4 Solid	278082	40
850,000 C. M. Stranded	278047	4 50	No. 3 Solid	278083	40
900,000 C. M. Stranded	278048	4 75	No. 2 Solid	278084	45
950,000 C. M. Stranded	278049	5 00	No. 1 Solid	278085	50
1,000,000 C. M. Stranded	278050	5 25	No. 0 Solid	278086	60
1,050,000 C. M. Stranded	278051	5 40	No. 00 Solid	278087	75
			No. 000 Solid	278088	90
			No. 0000 Solid	278089	1 10

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals above listed are provided.

Outline Dimensions in Inches

Size of Wire	A	B	C	D
14-12	1 1/8	3/8	3/8	1/4
10	1 1/8	7/16	3/8	3/8
8-6	1 1/8	1/2	3/8	3/8
5-4-3	1 1/2	9/16	1/2	3/8
2-1	1 7/8	1	5/8	3/8
0	2 1/8	1 1/8	3/4	3/8
00	2 1/4	1 1/4	7/8	3/8
000	2 5/8	1 3/8	1	3/8
0000	2 3/4	1 5/8	1 1/8	3/8
250,000-300,000	3	1 3/4	1 1/4	3/8
350,000-400,000	3 1/4	1 7/8	1 1/2	3/8
450,000-500,000	3 1/2	1 7/8	1 1/2	3/8
550,000-650,000	3 3/4	1 7/8	1 1/2	3/8
700,000-750,000	4 1/8	1 7/8	1 1/2	3/8
800,000-900,000	4 5/8	2	1 1/2	3/8
950,000-1,000,000	4 3/4	2 1/8	1 3/4	3/8
1,250,000-1,400,000	5	2 1/4	1 3/4	3/8
1,500,000-1,600,000	5 1/4	2 1/2	2	3/8
1,700,000-1,800,000	5 5/8	2 5/8	2	3/8
1,900,000-2,000,000	6	2 3/4	2 1/4	3/8
2,500,000	6 1/4	3 5/8	2 1/2	1



Order by Style Number

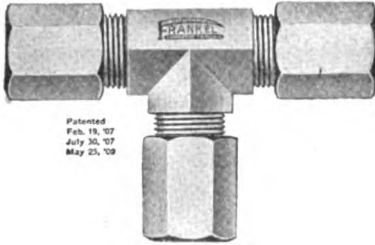
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WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

THREE-WAY CONNECTORS

Frankel No. 2561

Three-way connectors are used to make a main-line splice that is on a straight line, and a branch splice off of the main. If the main does not have to be cut except to make this connection, use a cable tap as listed on pages 1070 and 1071. They can



be furnished to connect any three sizes of solid wire or stranded cable.

All three-way connectors are special owing to the large number of possible combinations of sizes in main or branch. Orders should specify "Three-way

connectors, FRANKEL STYLE NO. 2561, mains for ..... (giving number or size of solid wire or cable for both ends of main;) branch for ..... (giving number or size of wire or cable)..... finish."

List price covers connection with mains and branch of same size. To ascertain the list price of connectors having different size mains and branch, take 1/3 the list price of each of the three required sizes and the sum of these three results will be the total list price. For example, the list price for a three-way connector for 400,000 c. m. to 300,000 c. m. cables in main to branch for 0000 cable is found as follows:

1/3 list price of three-way for 400,000 c.m. (list price \$3.00) = \$1.00  
 1/3 list price of three-way for 300,000 c.m. (list price \$2.25) = .75  
 1/3 list price of three-way for 0000 (list price \$1.65) = .55  
 Total list price..... \$2.30

Or, if both mains are 400,000 c.m., and branch 0000 cable:  
 2/3 list price of three-way for 400,000 c.m. (list price \$3.00) = \$2.00  
 1/3 list price of three-way for 0000 (list price \$1.65) = .55  
 Total list price..... \$2.55

Size of Wire or Cable*	List Price Plain Finish
14 to 6	\$0 55
5 to 3	60
2	70
1	75
0	90
00	1 10
000	1 35
0000	1 65
250,000	1 95
300,000	2 25
350,000	2 60
400,000	3 00

Size of Wire or Cable*
450,000
500,000
550,000
600,000
650,000
700,000
750,000
800,000
850,000
900,000
950,000
1,000,000

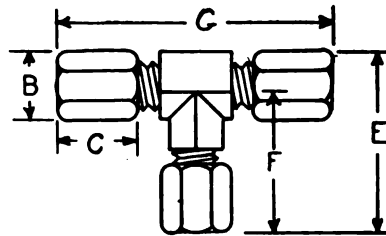
List Price Plain Finish
\$3 40
3 90
4 40
4 80
5 25
5 60
6 00
6 40
6 75
7 00
7 50
7 80

Size of Wire or Cable*	List Price Plain Finish
1,100,000	\$ 8 25
1,200,000	9 00
1,300,000	9 75
1,400,000	10 50
1,500,000	11 20
1,600,000	12 00
1,700,000	12 75
1,800,000	13 50
1,900,000	14 25
2,000,000	15 00
2,500,000	18 00

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals above listed are provided.

Outline Dimensions in Inches

Size of Wire	F	B	C	E	G
14-12	3/4	3/8	3/8	1/2	1 1/2
10	3/4	7/8	3/8	1/2	1 1/2
8-6	3/4	1 1/8	3/8	1/2	1 1/2
5-4-3	1 1/8	1 1/8	1/2	1 1/2	2 1/8
2-1	1 1/2	1 3/8	5/8	1 1/2	2 1/2
0	1 1/2	1 3/8	5/8	1 7/8	2 3/8
00	1 5/8	1 3/8	5/8	2	3 1/8
000	1 3/4	1 3/8	7/8	2 1/8	3 1/2
0000	1 3/4	1 3/8	7/8	2 1/4	3 1/2
250,000-300,000	2	1 3/8	7/8	2 1/2	4
350,000-400,000	2 1/4	1 3/8	1 1/8	2 3/4	4 1/2
450,000-500,000	2 1/4	1 3/8	1 1/8	3 1/4	5 1/4
550,000-650,000	2 3/4	1 3/8	1 1/4	3 3/8	5 1/8
700,000-750,000	2 3/4	1 3/8	1 1/4	3 1/2	5 1/2
800,000-900,000	3 1/4	2	1 1/2	4 1/8	6 1/2
950,000-1,000,000	3 1/4	2 1/8	1 5/8	4 1/4	6 1/2
1,250,000-1,400,000	3 5/8	2 1/4	1 7/8	4 3/4	7 1/2

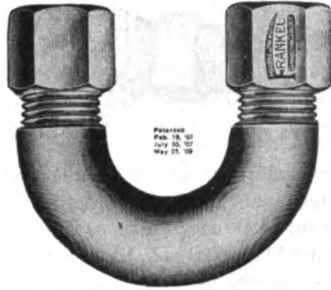


Order by Style Number

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

U CONNECTORS

Frankel No. 2558



Westinghouse-Frankel U connectors are used where it is desired to connect the ends of two parallel leads together such as resistance or heating element units. U connectors can be supplied with outlets of two different sizes if desired.

When ordering, specify distance between centers of outlets.

Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
14 to 6	\$0 45	450,000	\$2 80	1,100,000	\$ 6 90
5 to 3	50	500,000	3 25	1,200,000	7 20
2	55	550,000	3 65	1,300,000	7 80
1	65	600,000	4 00	1,400,000	8 75
0	75	650,000	4 40	1,500,000	9 75
00	95	700,000	4 70	1,600,000	10 60
000	1 15	750,000	5 00	1,700,000	11 60
0000	1 40	800,000	5 30	1,800,000	12 50
250,000	1 65	850,000	5 70	1,900,000	13 50
300,000	1 90	900,000	6 00	2,000,000	14 50
350,000	2 20	950,000	6 25	2,500,000	15 50
400,000	2 50	1,000,000	6 60		

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25 % to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals listed above are provided.

Y CONNECTORS

Frankel No. 2559

The Westinghouse-Frankel Y connector is used to make a three-way splice when the cables are not at right angles to each other.

This connector can be furnished to connect any three sizes of wire, cable or rod.

When ordering, state sizes required and type of wire or cable.

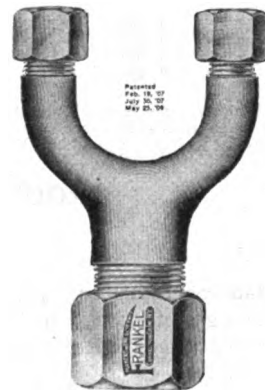
To ascertain list price of special size connectors of different sizes, take  $\frac{2}{3}$  of the price of the larger size and  $\frac{1}{3}$  of the other size. For example:

If the main splice is 400,000 C.M., and the branches 0000 cable.

$\frac{2}{3}$  list price of 400,000 C.M., (List Price, \$3.50) .. \$2 33

$\frac{1}{3}$  list price of 0000 C.M., (List Price, \$2.00)..... 67

Total List Price.. \$ 3 00



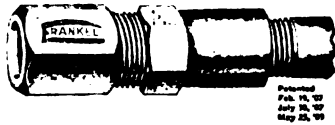
Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
14 to 6	\$0 60	450,000	\$4 00	1,100,000	\$ 9 75
5 to 3	70	500,000	4 50	1,200,000	10 00
2	80	550,000	5 10	1,300,000	11 00
1	90	600,000	5 70	1,400,000	12 50
0	1 10	650,000	6 20	1,500,000	13 50
00	1 30	700,000	6 50	1,600,000	15 00
000	1 60	750,000	7 00	1,700,000	16 50
0000	2 00	800,000	7 50	1,800,000	17 50
250,000	2 30	850,000	8 00	1,900,000	19 00
300,000	2 70	900,000	8 25	2,000,000	20 25
350,000	3 00	950,000	8 75	2,500,000	21 50
400,000	3 50	1,000,000	9 25		

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25 % to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals listed above are provided.

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

**PLUG-STUD CONNECTORS**

Frankel No. 2563



Patented Feb. 19, '22 July 30, '22 May 23, '22

Plug-stud connectors are used for connecting stranded cable or solid wire to a threaded stud or rod. All plug-stud connectors are special, owing to the possible combinations of sizes.

Orders should specify, "Plug-stud connectors, FRANKEL STYLE No. 2563, for.....(giving number or size of cable or solid wire for connector end) and.....(giving diameter or threads per inch of the stud to which the connector is to be attached).....finish."

List price covers connector in which the diameter of stud specified is not greater than the diameter of wire or cable. Special prices will be quoted for plug-stud connectors drilled and tapped for larger diameter studs than the size specified for wire or cable.

Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
14 to 6	\$0 30	450,000	\$1 80
5 to 3	35	500,000	2 00
2	40	550,000	2 30
1	45	600,000	2 60
0	50	650,000	2 80
00	60	700,000	3 00
000	70	750,000	3 20
0000	80	800,000	3 40
250,000	1 00	850,000	3 60
300,000	1 20	900,000	3 80
350,000	1 40	950,000	4 00
400,000	1 60	1,000,000	4 20

**STUD CONNECTORS**

Frankel No. 2564



Patented Feb. 19, '22 July 30, '22 May 23, '22

Stud connectors are used to connect wire or cable to block terminals by screwing the stud end of the connector into a threaded hole, or to strap terminals by inserting the stud end through a hole in the strap and clamping by a nut on the end of the stud.

All stud connectors are special owing to the possible combinations of sizes. Order should specify, "Stud connectors, FRANKEL STYLE No. 2564, for.....(giving number or size of cable or solid wire) and.....(giving length and diameter of plug wanted and number of threads per inch).....finish."

List price covers connector for size of wire or cable as listed and with ordinary diameter and length of stud. For extra large diameter or length of stud special prices will be quoted.

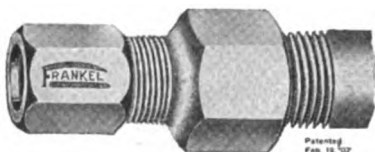
Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
1,100,000	\$4 40	1,900,000	7 60
1,200,000	4 60	2,000,000	8 00
1,300,000	5 00	2,500,000	9 80
1,400,000	5 60		
1,500,000	6 20		
1,600,000	6 40		
1,700,000	6 80		
1,800,000	7 20		

\*Wire and cable numbers are B. and S. standard gauge. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals above listed are provided. For polished and lacquered finish add 25% to list prices above.

**GROUNDING TAP CONNECTORS**

Frankel No. 2565

Grounding tap connectors are used to connect wire or cable to a gas pipe for grounding a circuit. The pipe end of the connector is threaded to receive



Patented Feb. 19, '22 July 30, '22 May 23, '22

a standard gas pipe of size specified. All grounding tap connectors are special owing to the possible combinations of sizes. Order should specify, "Grounding tap connectors, FRANKEL STYLE No.

2565, for.....(giving number and size of cable or solid wire) and.....(giving standard size of gas pipe).....finish."

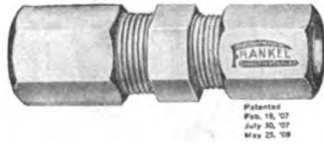
Special prices will be quoted on grounding tap connectors of sizes other than listed below.

Size of Wire or Cable*	Size of Pipe Inches	List Price Plain Finish
14 to 1	3/8	\$0 40
14 to 1	1/2	45
14 to 1	3/4	60
14 to 1	1	75
0 to 0000	1 1/8	75
0 to 0000	1 1/4	80
0 to 0000	1 1/2	85

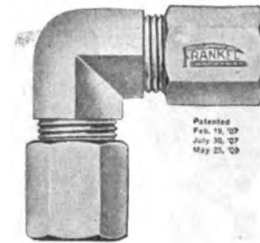
\*Wire and cable numbers are B. and S. standard gauge. See table preceding lists of connectors for diameter of solid wire or cable for which the standard terminals above listed are provided. For polished and lacquered finish add 25% to list prices above.

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

**REDUCERS**  
Frankel No. 2586



**ELBOWS**  
Frankel No. 2562



Reducers are used for connecting two conductors of different sizes of cable or solid wire. They are especially useful in connecting solid round busses on switchboards to feeder cables.

All reducers are special, owing to the possible combinations of sizes. Order should specify "Reducers, FRANKEL STYLE No. 2586, for..... (giving number or size of solid wire or cable for each end.).....finish."

Elbow connectors are used to connect conductors at right angles, these conductors being of the same or any two different sizes. All elbow connectors are special, owing to the possible combinations of sizes.

Order should specify "Elbow connectors, FRANKEL STYLE No. 2562, for.....(giving number or size of solid wire or cable for each end.).....finish."

List price covers connector with both ends of the same size. To ascertain the list price of connectors having different size ends, take 1/2 the list price of each of the two required sizes and the sum of these results will be the total list price.

For example, the list price of an elbow or reducer to connect a No. 0000 cable to a No. 0 cable is obtained as follows:

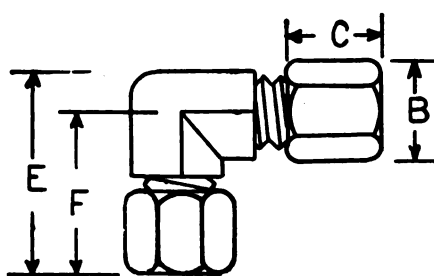
1/2 list price of No. 0000 (list price \$1.10) =	\$0.55
1/2 list price of No. 0 (list price .60) =	.30
<b>Total list price.....</b>	<b>\$0.85</b>

Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*
14 to 6	\$0 35	450,000
5 to 3	40	500,000
2	45	550,000
1	50	600,000
0	60	650,000
00	75	700,000
000	90	750,000
0000	1 10	800,000
250,000	1 30	850,000
300,000	1 50	900,000
350,000	1 75	950,000
400,000	2 00	1,000,000

List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
\$2 25	1,100,000	\$ 5 50
2 60	1,200,000	6 75
2 90	1,300,000	8 25
3 25	1,400,000	7 00
3 50	1,500,000	7 75
3 75	1,600,000	8 50
4 00	1,700,000	9 25
4 25	1,800,000	10 00
4 50	1,900,000	10 75
4 75	2,000,000	11 50
5 00	2,500,000	12 25
5 25		

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals above listed are provided.

Outline Dimensions of Elbows in Inches

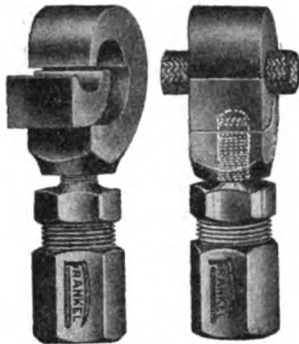


Size of Wire	B	F	C	E
14-12	3 3/8	7/8	3/4	1 1/4
10	3 1/2	7/8	3/4	1 1/4
8-6	3 3/4	1	3/4	1 1/4
5-4-3	3 5/8	1	3/4	1 1/4
2-1	3 3/4	1 1/4	3/4	1 3/8
0	3 5/8	1 1/2	3/4	1 3/8
00	3 3/4	1 1/2	3/4	1 3/8
000	3 5/8	1 3/4	3/4	1 3/8
0000	3 3/4	1 3/4	3/4	1 3/8
250,000-300,000	3 5/8	2	3/4	1 3/8
350,000-400,000	3 3/4	2 1/4	1 1/4	2 1/8
450,000-500,000	3 5/8	2 3/4	1 1/4	2 1/8
550,000-650,000	3 3/4	2 3/4	1 1/4	2 1/8
700,000-750,000	3 5/8	2 3/4	1 1/4	2 1/8
800,000-900,000	2	3	1 1/4	4
950,000-1,000,000	2 3/8	3 3/8	1 3/8	4 1/4

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

CABLE TAPS

Frankel No. 2575



SAME SIZE MAIN AND BRANCH



MAIN FOR 1,500,000 CM STRANDED CABLE  
BRANCH FOR 00 STRANDED CABLE

Cable taps are used to connect a branch of solid wire or stranded cable to main cable or wire. They should always be used for such connections when the main does not have to be cut for other reasons. The tap consists of a hook for clamping on the main, and a connector attached to the shank of the hook for taking the branch. The hook is provided with an inner shoe, which can be adjusted by turning the shank or post of the tap.

The cable tap is connected to the main by placing the hook over the wire or cable from which the insulation has been removed and then inserting the shoe and screwing up the post until contact is made. The branch is connected by inserting the bared end of the wire or cable in the connector and tightening the compression nut.

Style number covers cable tap for same size main and branch with plain finish only.

Taps differing from the standard listed style numbers should be specified as "FRANKEL STYLE No. 2575, for . . . . . (giving number or size of solid wire or cable of both main and branch)."

List Price covers cable tap for branch and main of same size. To ascertain the list price of taps for different size main and branch, take  $\frac{3}{4}$  the list price of the larger size plus  $\frac{1}{4}$  the list price of the smaller size.

For example, the list price of a tap for a 400,000 C. M. main with a No. 0000 branch is obtained as follows:

$\frac{3}{4}$ list price 400,000 C. M. main	(list price \$3.00) =	\$2.00
$\frac{1}{4}$ list price No. 0000 branch	(list price \$1.65) =	.55
Total list price . . . . .		\$2.55

Size of Wire or Cable*	Style No.	List Price Plain Finish	Size of Wire or Cable*	Style No.	List Price Plain Finish
No. 14 Stranded	276090	\$0 55	550,000 C. M. Stranded	276116	\$ 4 40
No. 12 Stranded	276091	55	600,000 C. M. Stranded	276117	4 80
No. 10 Stranded	276092	55	650,000 C. M. Stranded	276118	5 25
No. 9 Stranded	276093	55	700,000 C. M. Stranded	276119	5 60
No. 8 Stranded	276094	55	750,000 C. M. Stranded	276120	6 00
No. 7 Stranded	276095	55	800,000 C. M. Stranded	276121	6 40
No. 6 Stranded	276096	55	850,000 C. M. Stranded	276122	6 75
No. 5 Stranded	276097	60	900,000 C. M. Stranded	276123	7 00
No. 4 Stranded	276098	60	950,000 C. M. Stranded	276124	7 50
No. 3 Stranded	276099	60	1,000,000 C. M. Stranded	276125	7 80
No. 2 Stranded	276100	70	1,050,000 C. M. Stranded	276126	8 00
No. 1 Stranded	276101	85	1,100,000 C. M. Stranded	276127	8 25
No. 0 Stranded	276102	90	1,150,000 C. M. Stranded	276128	8 65
No. 00 Stranded	276103	1 10	1,200,000 C. M. Stranded	276129	9 00
No. 000 Stranded	276104	1 35	1,250,000 C. M. Stranded	276130	9 40
No. 0000 Stranded	276105	1 65	1,300,000 C. M. Stranded	276131	9 75
80,000 C. M. Stranded	276106	85	1,350,000 C. M. Stranded	276132	10 15
100,000 C. M. Stranded	276107	90	1,400,000 C. M. Stranded	276133	10 50
150,000 C. M. Stranded	276108	1 30	1,450,000 C. M. Stranded	276134	10 85
200,000 C. M. Stranded	276109	1 60	1,500,000 C. M. Stranded	276135	11 20
250,000 C. M. Stranded	276110	1 95	1,550,000 C. M. Stranded	276136	11 60
300,000 C. M. Stranded	276111	2 25	1,600,000 C. M. Stranded	276137	12 00
350,000 C. M. Stranded	276112	2 60	1,650,000 C. M. Stranded	276138	12 40
400,000 C. M. Stranded	276113	3 00	1,700,000 C. M. Stranded	276139	12 75
450,000 C. M. Stranded	276114	3 40	1,750,000 C. M. Stranded	276140	13 15
500,000 C. M. Stranded	276115	3 90	1,800,000 C. M. Stranded	276141	13 50

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or cable for which the standard terminals listed above are provided.

Order by Style Number

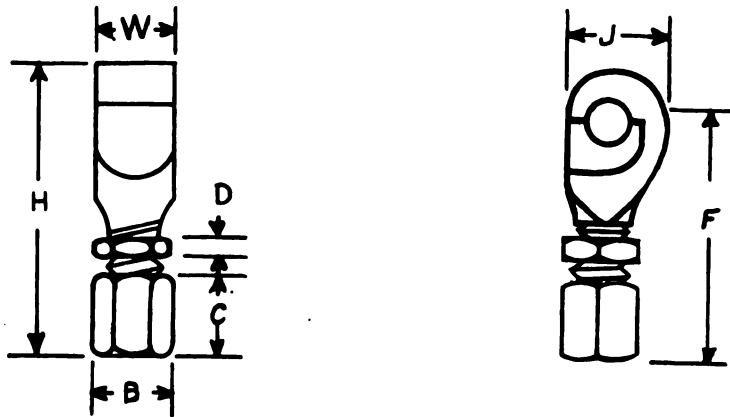
WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

CABLE TAPS—Continued

Size of Wire or Cable*	Style No.	List Price Plain Finish	Size of Wire or Cable*	Style No.	List Price Plain Finish
1,850,000 C. M. Stranded	276142	\$13 90	No. 7 Solid	276154	\$0 55
1,900,000 C. M. Stranded	276143	14 25	No. 6 Solid	276155	55
1,950,000 C. M. Stranded	276144	14 65	No. 5 Solid	276156	60
2,000,000 C. M. Stranded	276145	15 00	No. 4 Solid	276157	60
2,500,000 C. M. Stranded	276146	18 00	No. 3 Solid	276158	60
No. 18 Solid	276147	55	No. 2 Solid	276159	70
No. 16 Solid	276148	55	No. 1 Solid	276160	85
No. 14 Solid	276149	55	No. 0 Solid	276161	90
No. 12 Solid	276150	55	No. 00 Solid	276162	1 10
No. 10 Solid	276151	55	No. 000 Solid	276163	1 35
No. 9 Solid	276152	55	No. 0000 Solid	276164	1 65
No. 8 Solid	276153	55			

\*Wire and cable numbers are B. and S. standard gauge.  
 For polished and lacquered finish add 25% to list prices above.  
 See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard cable taps listed above are provided.

Outline Dimensions in Inches



Size of Wire	H	B	C	J	F	W
14-12	1 5/8	3/8	3/8	5/8	1 1/2	5/8
10	1 3/8	3/8	3/8	5/8	1 1/2	5/8
8-6	1 3/4	3/8	3/8	5/8	1 1/2	5/8
5-4-3	2 1/8	3/8	3/8	5/8	1 3/4	5/8
2-1	2 1/4	3/8	3/8	5/8	2	5/8
0	2 3/4	3/8	3/8	5/8	2 1/4	5/8
00	3	3/8	3/8	5/8	2 1/2	5/8
000	3 1/4	1 1/8	3/8	1 1/8	2 3/4	5/8
0000	3 3/8	1 1/8	3/8	1 1/8	3	5/8
250,000-300,000	3 3/4	1 1/4	3/8	1 3/8	3 1/8	5/8
350,000-400,000	4 1/8	1 3/8	3/8	1 1/2	3 3/8	1 1/8
450,000-500,000	4 3/4	1 1/2	3/8	1 5/8	4	1 1/8
550,000-650,000	5 1/8	1 5/8	3/8	1 3/4	4 1/4	1 1/8
700,000-750,000	5 1/2	1 7/8	3/8	1 7/8	4 5/8	1 1/8
800,000-900,000	6 1/4	2	3/8	2 1/4	5 1/4	1 1/8
950,000-1,000,000	7	2 1/8	3/8	2 1/2	5 3/4	1 3/8
1,250,000-1,400,000	7	2 1/4	3/8	2 3/4	5 7/8	2 3/4
1,500,000-1,600,000	8	2 3/8	2	2 3/4	6 3/4	2



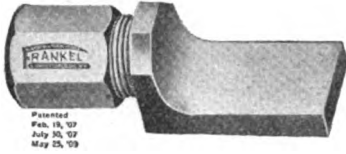
CLOSE-UP VIEW OF WESTINGHOUSE-FRANKEL CABLE TAP (WITH INSULATION REMOVED) IN PLANT OF FLATBUSH GAS COMPANY, BROOKLYN, N. Y.

Order by Style Number

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

FRONT CONNECTOR LUGS

Frankel No. 2568

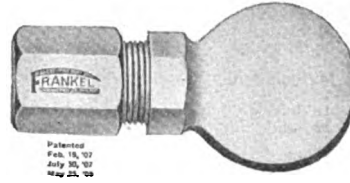


Front connector lugs are used for connecting solid wire or cable to generator terminals on large machines or to flat bus-bars or front-connected switches. These connectors are made with rectangular contact surface undrilled, but will be furnished drilled when so specified, without addition to list price.

Orders should specify "Front connector lugs, FRANKEL STYLE No. 2568, for.....(giving number and size of cable or solid wire) and.....(giving length and width of contact surface, if special size is required, and diameter of hole in surface if desired).....finish."

BACK CONNECTOR LUGS

Frankel No. 2569



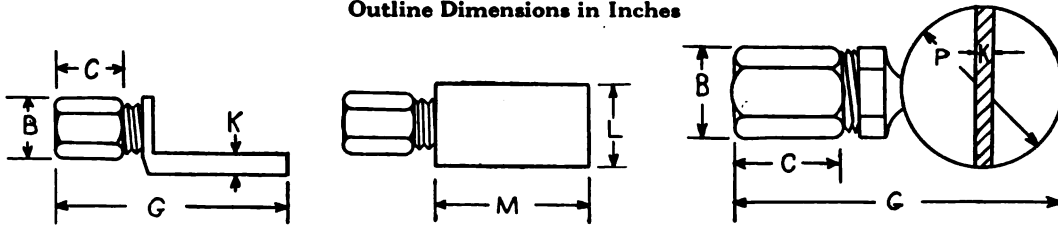
Back connector lugs are used for connecting solid wire or stranded cable to bolts or studs, and are made with round contact surface. Contact surfaces are undrilled, but where desired they will be furnished drilled when so specified, without addition to list price.

Orders should specify "Back connector lugs FRANKEL STYLE No. 2569, for.....(giving number and size of cable or solid wire) and.....(giving diameter of contact surface if special size is required, and diameter of hole in surface if desired).....finish."

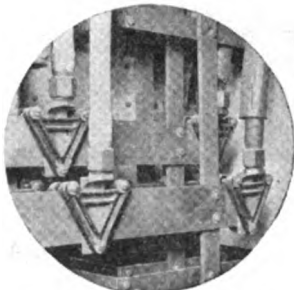
List Prices

For list prices of Front and Back Connector Lugs see list prices of Angle Connector Lugs and Right Angle Lugs on next page.

Outline Dimensions in Inches



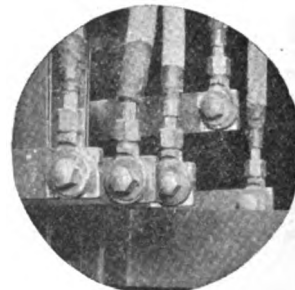
Size of Wire	L	M	K	G	B	C	Size of Wire	G	P	C	B	K
14-12	3/8	3/8	3/8	1 1/4	3/8	3/8	14-12	1 1/4	3/4	3/8	3/8	3/8
10	1/2	1/2	1/2	1 3/8	1/2	1/2	10	1 1/4	7/8	3/8	3/8	3/8
8-6	5/8	5/8	5/8	1 3/4	5/8	5/8	8-6	1 3/4	1 1/8	3/8	3/8	3/8
5-4-3	1	1	1	2 1/4	1	1	5-4-3	2	1 1/2	3/8	3/8	3/8
2-1	1 1/4	1 1/4	1 1/4	2 3/4	1 1/4	1 1/4	2-1	2 3/8	1 5/8	3/8	3/8	3/8
0	1 3/4	1 3/4	1 3/4	3 1/4	1 3/4	1 3/4	0	2 3/8	1 3/8	3/8	3/8	3/8
00	1 7/8	1 7/8	1 7/8	3 1/2	1 7/8	1 7/8	00	2 3/8	1 3/8	3/8	3/8	3/8
000	1 11/16	1 5/8	1 5/8	3 1/4	1 11/16	1 11/16	000	3	1 3/8	3/8	3/8	3/8
0000	1 1/2	1 5/8	1 5/8	3	1 1/2	1 1/2	0000	3 1/4	1 3/8	3/8	3/8	3/8
250,000-300,000	1 1/4	2	1 3/4	3 3/4	1 1/4	1 1/4	250,000-300,000	3 3/8	1 3/8	3/8	3/8	3/8
350,000-400,000	1 1/4	2	1 3/4	3 3/4	1 1/4	1 1/4	350,000-400,000	3 1/2	1 3/8	3/8	3/8	3/8
450,000-500,000	1 3/8	2	1 3/4	3 3/4	1 3/8	1 3/8	450,000-500,000	4	2	1 1/8	3/8	3/8
550,000-650,000	1 5/8	2 1/4	1 3/4	4 1/4	1 5/8	1 5/8	550,000-650,000	4 1/2	2 3/8	1 1/4	3/8	3/8
700,000-750,000	2	2 3/4	1 3/4	4 3/4	2	2	700,000-750,000	4 3/8	2 3/8	1 1/4	3/8	3/8
800,000-900,000	2	3	1 3/4	5	2	2	800,000-900,000	4 3/8	2 3/8	1 1/4	3/8	3/8
950,000-1,000,000	2	3	1 1/2	5 1/4	2 1/4	2 1/4	950,000-1,000,000	5	2 1/2	1 1/2	2	3/8
1,250,000-1,400,000	2 1/4	3 1/2	1 1/2	6 1/4	2 1/4	2 1/4	1,250,000-1,400,000	5 1/4	2 5/8	1 5/8	2 1/8	3/8
1,500,000-1,600,000	2 1/2	3 1/2	1 1/2	6 1/4	2 1/2	2 1/2	1,500,000-1,600,000					
1,700,000-1,800,000	2 3/4	3 3/4	1 1/2	6 1/4	2 3/4	2 3/4	1,700,000-1,800,000					
1,900,000-2,000,000	2 3/4	3 3/4	1 1/2	7	2 3/4	2 3/8	1,900,000-2,000,000					



PARTIAL VIEWS OF TWO LARGE INSTALLATIONS OF WESTINGHOUSE-FRANKEL SOLDERLESS LUGS IN NEW YORK CITY

LEFT: LUGS FASTENED TO BUS BARS BY MEANS OF CLAMPS ON 250-VOLT A-C. PANEL

RIGHT: LUGS CONNECTING CABLE LINES TO BUSES FOR KNIFE SWITCH AND CURRENT TRANSFORMER. 550-VOLT D-C.





WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

ANGLE CONNECTOR LUGS

Frankel No. 2570



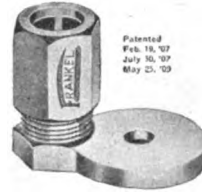
Angle connector lugs are made with round or rectangular contact surface at an angle of 45° to the connector. Contact surfaces are undrilled but where desired they will be furnished drilled without addition to list price.

Frankel No. 2570 has round contact surface; No. 2571 has rectangular contact surface.

Orders for round-surface lugs should specify "Angle connector lugs with round surface, FRANKEL STYLE NO. 2570, for . . . . . (giving number and size of cable or solid wire) and . . . . . (giving diameter of contact surface if special size is required, and diameter of hole in surface if desired) . . . . . finish." Orders for rectangular surface lugs should specify "Angle connector lugs with rectangular surface, FRANKEL STYLE NO. 2571, for . . . . . (giving number and size of cable or solid wire) and . . . . . (giving length and width of contact surface if special size is required, and diameter of hole in surface if desired) . . . . . finish."

RIGHT ANGLE LUGS

Frankel No. 2572



Right angle connector lugs are made with round or rectangular contact surface at an angle of 90° to the connector. Contact surfaces are undrilled, but where desired they will be furnished drilled when so specified, without addition to list price.

Frankel No. 2572 has round contact surface; No. 2573 has rectangular contact surface.

Orders for round-surface connectors should specify "Right angle connector lugs with round surface, FRANKEL STYLE NO. 2572, for . . . . . (giving number and size of cable or solid wire) and . . . . . (giving diameter of contact surface if special size is required, and diameter of hole in surface if desired) . . . . . finish." Orders for rectangular-surface connectors should specify "Right angle connector lugs with rectangular surface, FRANKEL STYLE NO. 2573, for . . . . . (giving number and size of cable or solid wire) and . . . . . (giving length and width of contact surface if special size is required, and diameter of hole in surface if desired) . . . . . finish."

List Prices

List price covers front, back or angle connector lug or right angle lug of the size listed with contact surface undrilled, or, where specified, drilled.

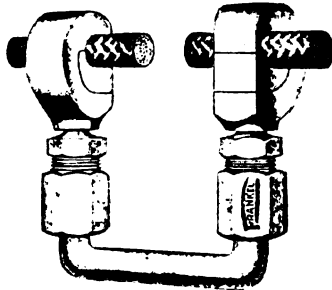
Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
14 to 6	\$0 25	450,000	\$1 65	1,100,000	\$4 10
5 to 3	30	500,000	1 80	1,200,000	4 30
2	35	550,000	2 00	1,300,000	4 60
1	40	600,000	2 30	1,400,000	4 90
0	45	650,000	2 50	1,500,000	5 20
00	55	700,000	2 70	1,600,000	5 60
000	65	750,000	2 90	1,700,000	6 00
0000	80	800,000	3 10	1,800,000	6 50
250,000	95	850,000	3 30	1,900,000	7 00
300,000	1 10	900,000	3 50	2,000,000	7 50
350,000	1 30	950,000	3 70	2,500,000	9 50
400,000	1 45	1,000,000	3 90		

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals above listed are provided.

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

EQUALIZERS

Equalizers are used to equalize the load on two power cables that run parallel or at right angles to each other. They are made by combining two



FRANKEL No. 2576

All equalizers are special because of the possible combinations of sizes. Orders for equalizers should specify "Equalizer, FRANKEL STYLE No. 2576 (or STYLE No. 2577), for.....(giving number or size of solid wire or stranded cable for each end) and.....(giving shape of connecting rod, distance between center of cables, and stating whether parallel or at right angles) ..... finish."



FRANKEL No. 2577

cable taps and are installed in the same manner that a cable tap is connected to a main. They are furnished with connecting rod straight or bent, as desired.

The price of equalizers is the same as that of two cable taps (see pages 1070 and 1071) of corresponding size plus a special price on connecting rods, which may be obtained on application.

SWIVEL LUGS

Frankel No. 2574

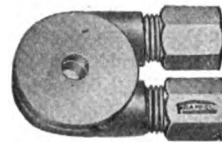
Swivel lugs consist of a combination of two round-surface lugs having the contact surface of one mounted on the contact surface of the other in such a way that a swiveling motion is permitted and cables or wires of any size coming from any two different directions may be connected.

All swivel lugs are special because of the possible combinations of sizes.

Orders should specify "Swivel lugs, FRANKEL STYLE No. 2574, for.....(giving number or size of solid wire or cable for each end) ..... finish."

List price covers lug with both ends of the same size. To ascertain the list price of lugs having different size ends, take 1/2 the list price of each

of the two required sizes and the sum of these results will be the total list price.



For example, the list price of a lug to connect No. 0000 cable to a No. 0 cable is obtained as follows:

$$\begin{aligned} \frac{1}{2} \text{ list price of No. 0000 (list price \$1.60)} &= \$0.80 \\ \frac{1}{2} \text{ list price of No. 0 (list price .90)} &= .45 \\ \text{Total list price} &= \$1.25 \end{aligned}$$

Size of Wire or Cable*	List Price Plain Finish	Size of Wire or Cable*
14 to 6	\$0 50	450,000
5 to 3	80	500,000
2	70	550,000
1	80	600,000
0	90	650,000
00	1 10	700,000
000	1 30	750,000
0000	1 60	800,000
250,000	1 90	850,000
300,000	2 20	900,000
350,000	2 60	950,000
400,000	2 90	1,000,000

List Price Plain Finish	Size of Wire or Cable*	List Price Plain Finish
\$3 30	1,100,000	\$8 20
3 60	1,200,000	8 80
4 00	1,300,000	9 20
4 60	1,400,000	9 80
5 00	1,500,000	10 40
5 40	1,600,000	11 20
5 80	1,700,000	12 00
6 20	1,800,000	13 00
6 60	1,900,000	14 00
7 00	2,000,000	15 00
7 40	2,500,000	19 00
7 80		

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or stranded cable for which the standard terminals listed above are provided.

WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

COLLETS

Frankel No. 2595



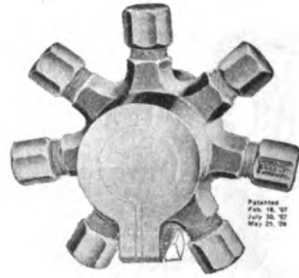
1 OUTLET

Frankel No. 2597



3 OUTLETS

Frankel No. 2599



7 OUTLETS

A Westinghouse-Frankel Collet consists of a threaded and split collar from which radiate 1, 2, 3, 5 or 7 Frankel fittings. Collets are particularly valuable for use with reactance coils but may be used wherever it is desired to connect one or more wires to a common stud.

When used with reactance coils, one or more collets are fastened on the stud at either end of the reactance coil and the wires of the coil are fastened in the Frankel fittings. The construction of the

collar insures perfect contact on the stud. Moreover, this form of connector will not come loose under the constantly changing current passing through reactance coils.

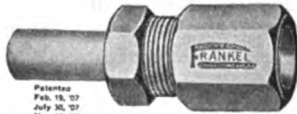
Westinghouse-Frankel Collets are made in any combination of sizes. When ordering, specify size of center hole, size and kind of wire and number of outlets required.

All collets are special. Prices on application.

SERVICE BOX PLUGS

Frankel No. 2566

Service box plug connectors are used for making connections to fuses where a round stud is required on the connector for use in a screw clamp terminal.



All service box plug connectors are special. Order should specify "Service box plug connectors, FRANKEL STYLE NO. 2566, for.....(giving number and size of cable or solid wire) and.....(giving diameter and length of plug)."

List price covers connector of size specified. Special prices will be quoted on connectors of larger sizes.

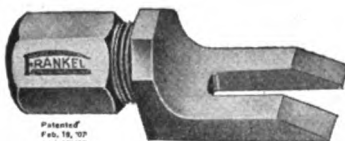
Size of Wire or Cable*	Length of Plug Inches	Diam. of Plug Inches	List Price Plain Finish
14 to 4	3/8	3/8	\$0 25
3 to 1	3/4	3/8	30
0	3/4	3/8	40
00	3/4	3/8	50
000	1	1/2	60
0000	1	1/2	65

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or cable for which the standard terminals above listed are provided.

SERVICE BOX LUGS

Frankel No. 2567

Service box lugs are used for connecting wires or cables to fuses where the terminal is a stud with a clamping nut or binding screw. The contact



surface is slotted so that it can be slipped over the stud or screw without removing the screw or nut. The lug ends are tapered to slip under the washer.

All service box lugs are special. When ordering specify "Service box lug connectors, FRANKEL

STYLE NO. 2567, for.....(giving number and size of cable or solid wire) and.....(giving length and width of base and size of slot)."

List price covers connector of the size listed with any size slot as ordered.

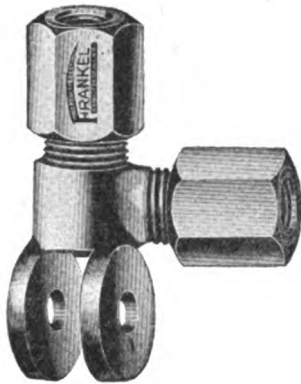
Size of Wire or Cable*	Base Width Inches	Base Length Inches	List Price Plain Finish
14 to 4	3/4	3/4	\$0 25
3 to 1	3/4	3/4	30
0	3/4	1	40
00	3/4	1	50
000	1	1 1/2	60
0000	1	1 1/2	70

\*Wire and cable numbers are B. and S. standard gauge. For polished and lacquered finish add 25% to list prices above. See table preceding lists of connectors for diameter of solid wire or cable for which the standard terminals above listed are provided.

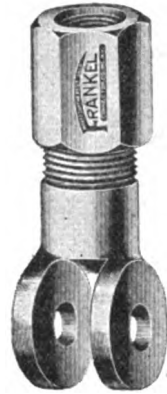
WESTINGHOUSE-FRANKEL SOLDERLESS CONNECTORS—Continued

CABLE ANCHORS

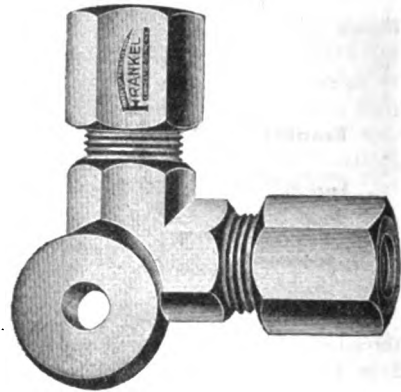
FRANKEL No. 2588



FRANKEL No. 2587



FRANKEL No. 2589



Cable Anchors, FRANKEL STYLE No. 2587, are used to connect the end of a cable to a strain insulator for the purpose of anchoring it. One end of the anchor is fitted with a standard Westinghouse-Frankel Solderless Fitting and the other end with a clevis to take a standard strain insulator.

Order should specify "Cable Anchor, FRANKEL STYLE No. 2587, for.....(giving number or size of solid wire or cable)..... finish."

List prices of cable anchors, FRANKEL STYLE No. 2587, are the same as list prices of two-way connectors No. 2560.

Cable Anchors, FRANKEL STYLE No. 2588 are used to anchor one cable and to take a branch wire off the anchored cable. They are similar to a three-way connector with one side of the main replaced by a clevis, the same as used on the anchor. FRANKEL STYLE No. 2587.

Order should specify "Cable Anchor, FRANKEL STYLE No. 2588, for.....(giving number or

size of solid wire or cable for main and branch)..... finish."

List prices of Cable Anchors Frankel No. 2588, are the same as for Three-Way Connectors Frankel No. 2561.

Cable Anchors, FRANKEL STYLE No. 2589, are used to splice and anchor two cables that are at right angles to each other. This anchor consists of an elbow connector and one eye for attaching the strain insulator by means of a guy rope. The eye is so arranged that both cables will be on a tension when a strain is put on the guy rope.

Order should specify "Cable Anchor, FRANKEL STYLE No. 2589, for.....(giving number or size of cable or solid wire for both ends of the elbow)..... finish."

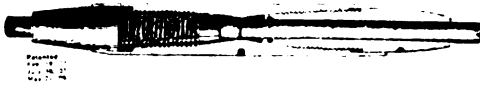
List prices of Cable Anchors, FRANKEL STYLE No. 2589, are the same as for three-way connectors, Frankel No. 2561.

TROLLEY WIRE SPLICING SLEEVES

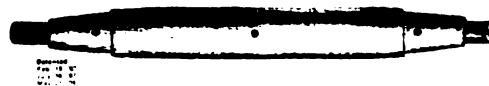
Frankel No. 2583

Westinghouse-Frankel splicing sleeves are used for connecting trolley wires without using solder. They consist of a center sleeve or nut having a right-hand thread in one end and a left hand thread

Orders should specify "Trolley wire splicing sleeve FRANKEL STYLE No. 2583, for..... (size of wire) and..... (giving material, brass or bronze)."



OPEN



CLOSED

in the other, and two end pieces that screw in the sleeve, or nut, clamp the ends of the wire. The end pieces have slotted tapering jaws with an open steel ring on the inside of the jaws. When the strain is applied, this ring forms and is upset.

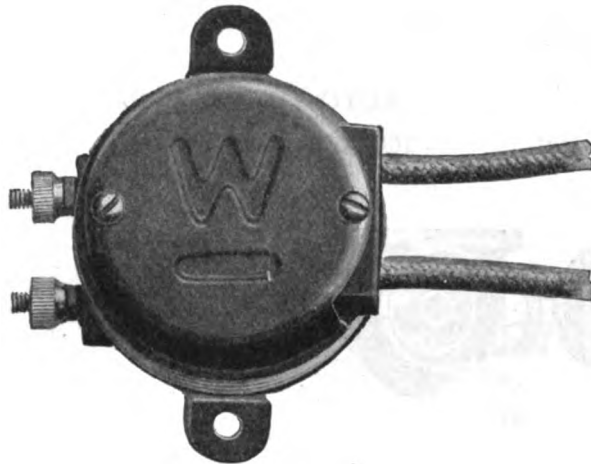
These sleeves are made of drawn brass or bronze.

Size of Wire*	List Price Each
0 Round Wire	\$4 00
00 Round Wire	5 00
000 Round Wire	6 00
0000 Round Wire	7 00

\*Wire numbers are B. & S. standard gauge. See table for diameter of solid wire for which the splicing sleeves above listed are provided. Made only in lots of 100 or more.

## BELL-RINGER

**Transforms Lighting Current to Proper Voltage for Doorbells, Buzzers and Other Low-voltage Devices**



A Westinghouse bell-ringer replaces dry-cell or wet-cell batteries for operating door bells, buzzers, miniature lamps, and other devices or apparatus requiring a low but dependable voltage. The bell-ringer reduces the 110-volt alternating current of the lighting circuit to the voltage required for bells, buzzers, etc.

Westinghouse bell-ringers are approved by the National Board of Fire Underwriters; they are as safe to use as an electric lamp. They can be installed by anyone in a few minutes and once installed, they eliminate door-bell or buzzer troubles for years. Their size is not an indication of their ability either, for if necessary, they can be depended on to operate a four-inch bell.

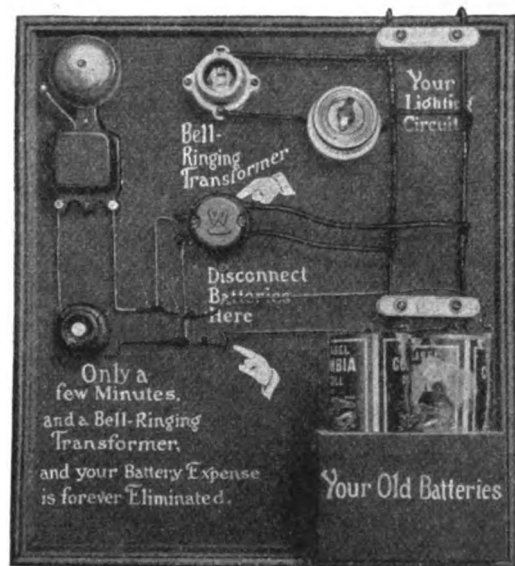
These bell-ringers are designed especially for regular alternating-current lighting circuits of 60-cycle frequency. **They cannot be used on direct-current circuits nor on alternating-current circuits of other than 60-cycle frequency.**

**Special Features**—Light in weight and compact in size. The secondary terminals can be short-circuited continuously without causing overheating. Westinghouse bell-ringers are **absolutely fireproof** and practically **indestructible**.

**Construction**—The best materials obtainable are embodied in these bell-ringers. The windings are covered with pressed sheet-steel end caps. The primary leads, which are connected to the 110-volt source of supply, issue through a porcelain bushing.

The connections to the bell are made with binding posts, which are mounted on a porcelain support.

**Capacity**—The bell-ringer has a rating of 10 volt-amperes. It delivers on open circuit 12 volts and it replaces several dry cells under ordinary conditions.



GRAPHIC ILLUSTRATION SHOWING IN MINIATURE HOW A WESTINGHOUSE BELL RINGER IS CONNECTED TO A LIGHTING CIRCUIT TO REPLACE BATTERIES

Primary Volts	Frequency Cycles	Height Inches	Width Inches	Depth Inches	Shipping Weight Each	Style No.	Price Each
110	60	2 $\frac{3}{4}$	2 $\frac{3}{4}$	2 $\frac{3}{4}$	1 Lb.	284615	\$1 50

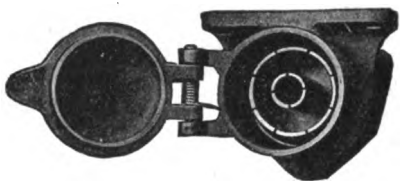
Order by Style Number

## TWO-WIRE CHARGING RECEPTACLES AND PLUGS

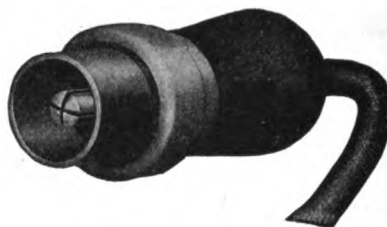
These receptacles and plugs are used in automobile garages, roundhouses, factories, and wherever it is desirable to have a detachable connection, as on a battery-charging circuit. Two styles are listed;

one especially adaptable to heavy automobile service, such as auto-trucks; the other for roundhouse and factory service.

### AUTO-TRUCK TYPE 100 Amperes—250 Volts



STYLE NO. 136468—CHARGING RECEPTACLE



STYLE NOS. 91193 AND 108380—CHARGING PLUG

This receptacle and plug are made for heavy service. Although particularly adapted for use with electric auto-trucks, their durable construction makes them desirable for use in all battery charging service on vehicles or otherwise. The insulation of both receptacle and plug is such that it is practically impossible to short-circuit either. Both are simply and strongly made and will stand hard service.

The receptacle consists of a cast-iron shell surrounding a moulded insulating material in which two phosphor-bronze tube-shaped contacts are imbedded concentrically. A hinged lid which is held closed by a spring when the plug is not in place

makes the receptacle dust-proof. Cables are readily attached at the rear by soldering into the removable part of the screw connectors furnished.

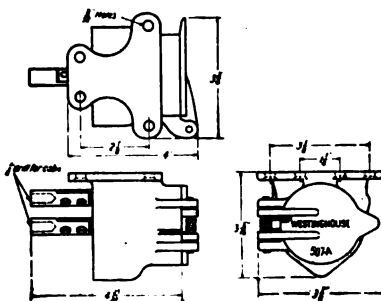
The body of the plug is of moulded insulating material and the handle is of wood; the two contact parts are of the best hard-drawn copper; the other metallic parts are of brass. The center contact is a pin with two saw cuts at right angles. This pin is held firmly in place by the insulating body in which it is mounted. The outer contact is tubular in shape and is supported on the same insulating body as the center contact. A sleeve of spun brass covers this insulating material and clamps it to the body of the plug.

### PRICES

Style number and list price include the receptacle or plug as described.

Style No.	Description	APPROX. WT., LBS.		List Price
		Net	Shipping	
136468	Type 507 charging receptacle, without cable.....	4	8	\$10 00
91193	Type 508-A charging plug, with two 11-foot cables.....	7	14	18 00
108380	Type 508-A charging plug with two 1-foot cables.....	3	6	11 00

### OUTLINE DIMENSIONS



Order by Style Number

TWO-WIRE CHARGING RECEPTACLES AND PLUGS—Continued

ROUNDHOUSE AND FACTORY TYPE

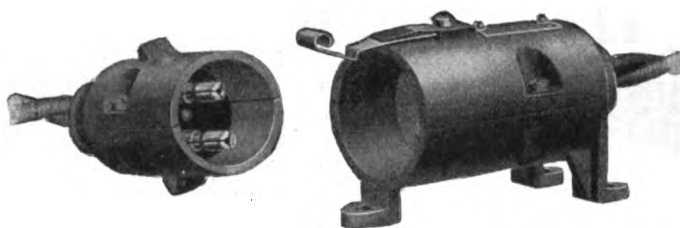
25 Amperes—250 Volts

This receptacle and plug are especially adapted for hard service and rough usage. They are used in engine houses and in other places where particularly strong and durable apparatus is desired.

In construction the receptacle consists of a cast-iron shell containing two copper contacts mounted in a fireproof insulating block. The terminals of these contacts are thoroughly insulated from each other by an insulating compound which is poured into the shell when liquid, and fills, when cold, every

part of the interior. Short-circuiting between terminals of the receptacle is therefore impossible. The back of the receptacle furnished without cables is threaded for 3/4-inch pipe to enable its use on a conduit system.

The plug consists of a cast-iron shell containing two split copper pins, imbedded in insulating material. A short-circuit is impossible between the pins. When the plug is inserted in the receptacle it is held in place by a spring clip.



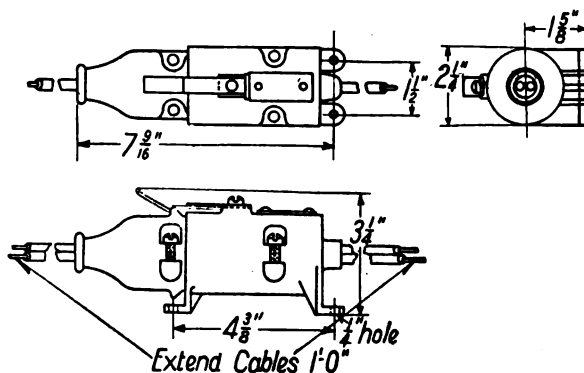
STYLE NO. 112537 CHARGING PLUG      STYLE NO. 112538 CHARGING RECEPTACLE

PRICES

Style number and list price include the receptacle or plug complete as described, except that where furnished without cables, the insulating compound around the terminals must be put in by the purchaser after inserting the cables.

Style No.	Description	APPROX. Wt., Lbs. Net	Lbs. Shipping	List Price
104391	Charging plug, without cable.....	3	6	\$4 00
112537	Charging plug, with two 1-foot cables.....	4	8	5 25
104392-C	Charging receptacle, without cable.....	4	6	5 75
112538	Charging receptacle, with two 1-foot cables.....	5	8	7 00

OUTLINE DIMENSIONS



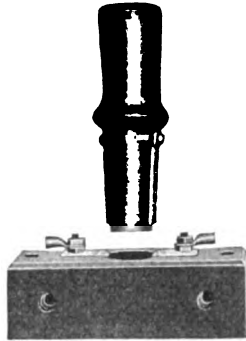
These dimensions are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number

# PLUGS AND RECEPTACLES

## SCHEDULE L

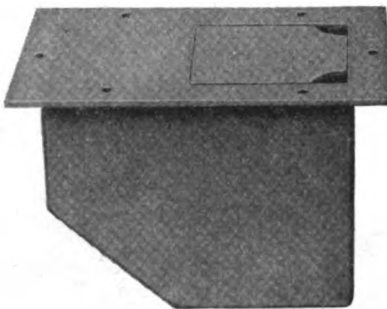
A simple and satisfactory plug connector adapted to a great variety of uses—connecting stage lighting apparatus, portable motors, electrically-driven tools, and for charging automobiles. Polarized plugs will be supplied without additional charge when so ordered.



TWO-POLE PLUG AND RECEPTACLE



WALL BOX



FLOOR BOX

### TWO-POLE PLUGS AND RECEPTACLES

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
<b>50 Amperes, 125 Volts</b>				
W22914	Plug and receptacle . . .	15	5	\$3 50
W22915	Plug only . . . . .	15	2	1 25
W22916	Receptacle only . . . . .	15	3	2 25
<b>50 Amperes, 250 Volts</b>				
W22917	Plug and receptacle . . .	10	5	6 00
W22918	Plug only . . . . .	10	2	2 50
W22919	Receptacle only . . . . .	10	3	3 50
<b>100 Amperes, 250 Volts</b>				
W25022	Plug and receptacle . . .	10	11	7 50
W25023	Plug only . . . . .	10	2	3 25
W25024	Receptacle only . . . . .	10	10	4 25

### WALL BOXES FOR PLUGS AND RECEPTACLES

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
W22923	Box for one two-pole, 50-ampere, 125-volt plug and receptacle only . . . . .	10	10	\$2 25
W22880	Box for one two-pole, 50-ampere, 250-volt plug and receptacle only . . . . .	10	11	2 75

NOTE:—Prices of wall boxes for more than one plug and receptacle, or for 100-ampere, 250-volt plugs and receptacles, quoted on application.

When installed in the lecture rooms of educational institutions or similar places, these plugs and receptacles should be used with a flush type box equipped with a lock and key. Prices quoted on application.

### STAGE FLOOR BOXES FOR PLUGS AND RECEPTACLES

These boxes are substantially made of heavy gauge steel supplied with either a cast iron or a boiler plate cover, and an open bottom. Designed to accommodate two two-pole, 125 or 250-volt plugs and receptacles of the 50-ampere size only.

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
W22924	Box only, with cast iron cover . . . . .	10	30	\$4 75
W22925	Box only with boiler plate cover . . . . .	10	30	8 00

NOTE:—Prices of Floor Boxes to accommodate three or four-pole plugs and receptacles, or plugs of larger capacity quoted on request.



PLUGS AND RECEPTACLES—Continued

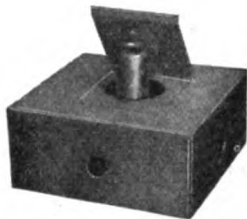
SCHEDULE L



THREE-POLE PLUG AND RECEPTACLE



THREE-POLE PLUG AND RECEPTACLE ASSEMBLED



WALL BOX WITH THREE-POLE PLUG AND RECEPTACLE

THREE-POLE PLUGS AND RECEPTACLES

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
<b>50 Amperes, 250 Volts</b>				
W22920	Plug and receptacle . . . . .	10	15	\$11 00
W22921	Plug only . . . . .	10	3	4 00
W22922	Receptacle only . . . . .	10	12	7 00
<b>100 Amperes, 250 Volts</b>				
W25025	Plug and receptacle . . . . .	10	21	14 85
W25026	Plug only . . . . .	10	3	5 40
W25027	Receptacle only . . . . .	10	19	9 45
<b>50 Amperes, 600 Volts</b>				
W25028	Plug and Receptacle . . . . .	10	12	35 00
W25029	Plug only . . . . .	10	4	23 00
W25030	Receptacle only . . . . .	10	10	12 00

FOUR-POLE PLUGS AND RECEPTACLES

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
<b>50 Amperes, 250 Volts</b>				
W25031	Plug and receptacle . . . . .	10	11	\$13 75
W25032	Plug only . . . . .	10	2	5 00
W25033	Receptacle only . . . . .	10	10	8 75

WALL BOXES FOR PLUGS AND RECEPTACLES

Style No.	Description	Std. Pkg.	Wt., Lbs. Boxed	List Price
W30200	Box only for 50-ampere 250-volt, three and four-pole plugs and receptacles . . . . .	10	20	\$3 50
W30534	Box only for 100 amp., 250 volt 3-pole Receptacle . . . . .			7 00
W30535	Box only for 50 amp., 600 volt, 3-pole Receptacle . . . . .			10 00

NOTE:—Wall boxes will be made to accommodate larger sizes of three and four-pole plugs and receptacles. Prices quoted on application.

# STEEL SERVICE AND CUT-OUT BOXES

## Schedule O—Standard Package, 5 of One Size

### SPECIFICATIONS



The following specifications apply to all Cut-out Boxes:

Steel Service and Cut-out Boxes are formed up from a single piece of sheet steel and electrically welded. There are no rivets to work loose.

Finished with high grade black enamel paint.

Underwriters' label on every box—approved by the National Board of Fire Underwriters.

Four 5/8-inch holes, one inch from each corner, for fastening cabinet in place.

### MACHINE-FORMED CUT-OUT BOXES

The following specifications apply only to stock cut-out boxes listed below and cannot be changed:

Doors overlap boxes on all four sides and are hinged on right-hand side.

Made for surface mounting.

Large quantities in stock for prompt shipment.

### PRICE LIST OF MACHINE-FORMED (STOCK) CUT-OUT BOXES

#### 16 U. S. Gauge Steel with 7/8-inch Knock-outs for 1/2-inch Conduit Pipes

Width Inches	Length Inches	LIST PRICE, EACH							
		Style No.	3 Inches Deep	Style No.	4 Inches Deep	Style No.	5 Inches Deep	Style No.	6 Inches Deep
4	6	W30857	\$0 37	W30860	\$0 42				
4	8	W30859	38	W30862	45				
4	10			W30864	42				
6	6	W30863	38	W30866	46				
6	8	W30865	40	W30868	53				
6	10	W30867	45	W30871	61				
6	12	W30870	54	W30873	73				
6	16	W30872	67	W30875	59				
8	8	W30874	45	W30877	64				
8	10	W30876	51	W30879	72				
8	12	W30878	61	W30883	86				
8	16	W30882	78	W30887	73				
10	10	W30886	62	W30889	83				
10	12	W30888	70	W30891	98				
10	16			W30893	1 13				
10	18			W30894	92				
12	12	W30890	89	W30895	1 16				
12	16	W30892	1 05	W30896	1 43				
12	18			W30897	1 75				
12	20			W30898	2 00				
12	24								

**Special Prices:**

Style No. 30899, 4 1/4 x 9 x 3 1/2 box hinged at top instead of right hand side (with 7/8-inch knock-outs)	\$0 43
When ordered in lots of 50 or with 10 or more standard packages of stock boxes, use list price	38

### No. 16 U. S. Gauge Steel Cut-out Boxes With Combination Knock-outs

One row of 7/8-inch knock-outs for 1/2-inch conduit pipe and one row of 5/8-inch knock-outs for 1/4-inch circular loom are furnished in the following boxes which are carried in stock.

Style No.	Dimensions	List Price
W30900	6 inches wide, 8 inches long, 4 inches deep	\$1 05
W30901	8 inches wide, 10 inches long, 4 inches deep	1 25
W30902	10 inches wide, 12 inches long, 4 inches deep	1 50
W30903	10 inches wide, 16 inches long, 4 inches deep	1 70

### No. 14 U. S. Gauge Steel Cut-out Boxes With Standard 7/8-inch Knock-outs for 1/2-inch Conduit Pipe

Doors overlap boxes on all four sides and are hinged on right hand (long) side.

Four 5/8-inch holes (1 inch from each corner) are provided for fastening box in place.

Style No.	Dimensions	List Price
W30904	12 inches wide, 30 inches long, 4 inches deep	\$4 15
W30905	18 inches wide, 24 inches long, 4 inches deep	4 60
W30906	18 inches wide, 36 inches long, 4 inches deep	6 30
W30907	18 inches wide, 42 inches long, 4 inches deep	7 10
W30908	18 inches wide, 48 inches long, 4 inches deep	7 75

This page covers Machine-Formed Boxes only. Even the slightest deviation in the above specifications requires a Hand-Formed Box and should be taken from the following pages.

STEEL SERVICE AND CUT-OUT BOXES—Continued

HAND-FORMED CUT-OUT BOXES—Schedule O

Boxes listed on the following pages are not regularly carried in stock but are made to order.

The following specifications apply:

**Knockouts**—Unless otherwise ordered, boxes will be furnished with standard 1/8-inch knock-outs for 1/2-inch conduit pipes. For knock-outs other than standard, add 10 cents list per box for each change in size of knock-out. Knock-outs for loom will be furnished when ordered, without additional charge, provided all knock-outs in the same box are of the same size.

**Mounting**—Made for surface mounting unless otherwise specified. **Flush Cutout Boxes**—use the following:

For 16-Gauge Flush Boxes, add 100% to list prices on this page.

For 14-Gauge Flush Boxes, add 55% to list prices on this page.

For 12-Gauge Flush Boxes, add 33% to list prices on this page.

For 10-Gauge Flush Boxes, add 33% to list prices on this page. (This addition does not apply to type "L" boxes.)

**Doors**—Unless otherwise ordered, all boxes will be furnished with hinged doors. Boxes ordered with covers fastened on with screws take same list prices as surface type boxes. Unless otherwise ordered, box doors will be made with all four sides overlapping and hinged on right-hand side. Doors

will be hinged at top when so ordered without additional charge.

For hasp and staple on door, add \$0.60 each to list. For boxes with doors omitted, deduct 20 per cent from the list. For boxes with sloping bottom, add 50 per cent to list. For commode catch, add 40 cents to list prices of boxes less than 6 inches deep; boxes over 6 inches deep are regularly furnished with commode catch. Prices of galvanized boxes will be quoted on application. For nickel-plated vault handle add \$1.00 list. For Yale cylinder lever lock, add \$0.70 list. For master keyed cylinder lever lock add \$1.00 list. For master keys add \$0.75 list for each key. For spring hinges on doors, add 30 cents list per hinge. (All boxes less than 32 inches long require 2 hinges; No. 14 U. S. gauge steel boxes over 32 inches long require 3 hinges; No. 12 and 10 U. S. gauge steel boxes over 36 inches long require 3 hinges; all boxes over 54 inches long require 4 hinges.)

**Weatherproof Boxes**—For weatherproof boxes galvanized according to Underwriters' code add 200 per cent to list price if made of 12 or 14 U. S. gauge steel; add 150 per cent if made of No. 10 U. S. gauge steel, each box to bear Underwriters' label. For plain steel boxes with overhanging and sloping roof, painted black, add 50 per cent. (Plain weatherproof boxes do not bear Underwriters' label. All other cut-out boxes are labeled.)

**Galvanized Boxes**—Add 65% for boxes made of Galvanized Steel.

PRICE LIST OF NO. 16 U. S. GAUGE STEEL BOXES

UNDERWRITERS' REQUIREMENTS { No one dimension to exceed 24 inches  
No one surface to exceed 360 square inches

Width Inches	Length Inches	DEPTH, INCHES																
		3	4	5	6	8	9	10	12	14	15							
4	4	\$1 05	\$1 20	\$1 35	\$1 55													
4	6	1 15	1 30	1 45	1 65													
4	8	1 25	1 40	1 60	1 80													
4	10	1 35	1 50	1 75	1 90													
6	6	1 25	1 45	1 60	1 80													
6	8	1 40	1 55	1 75	2 00													
6	9	1 45	1 60	1 85	2 10													
6	10	1 50	1 70	1 90	2 15													
6	12	1 60	1 80	2 05	2 30													
6	14	1 75	1 95	2 20	2 45													
6	15	1 80	2 05	2 25	2 50													
6	16	1 85	2 10	2 30	2 60													
8	8	1 50	1 70	1 90	2 15	\$2 70	\$2 80											
8	9	1 60	1 80	2 00	2 25	2 80	2 90											
8	10	1 70	1 90	2 10	2 35	3 10	3 19											
8	12	1 80	2 05	2 25	2 50	3 25	3 35											
8	14	1 95	2 15	2 40	2 70	3 55	3 64											
8	15	2 00	2 25	2 50	2 75	3 65	3 77											
8	16	2 10	2 35	2 60	2 85	3 80	3 95											
8	18	2 25	2 50	2 75	3 05	4 10	4 21											
8	20	2 45	2 70	3 00	3 35	4 35	4 50											
8	22	2 60	2 90	3 20	3 55	4 65	4 80											
10	10	1 85	2 05	2 25	2 55	3 25	3 35	\$3 50										
10	12	2 00	2 25	2 45	2 75	3 68	3 75	3 95										
10	14	2 15	2 40	2 55	2 95	3 85	4 00	4 20										
10	15	2 25	2 50	2 75	3 05	4 05	4 15	4 35										
10	16	2 35	2 60	2 85	3 15	4 20	4 35	4 60										
10	18	2 50	2 75	3 05	3 35	4 50	4 65	5 00										
10	20	3 05	3 35	3 70	4 05	4 80	4 95	5 30										
10	22	3 25	3 55	3 90	4 30	5 00	5 25	5 65										
10	24	3 40	3 75	4 15	4 50	5 40	5 55	6 00										
12	12	2 20	2 40	2 80	3 10	3 90	4 00	4 30	\$4 70									
12	14	2 40	2 60	3 00	3 30	4 25	4 35	4 65	5 10									
12	15	2 45	2 75	3 10	3 45	4 40	4 55	4 85	5 30									
12	16	2 55	2 85	3 25	3 55	4 60	4 70	5 05	5 50									
12	18	2 75	3 05	3 45	3 80	4 85	5 05	5 43	5 90									
12	20	3 40	3 70	4 05	4 30	5 25	5 50	5 80	6 30									
12	22	3 60	3 90	4 30	4 70	5 60	5 75	6 15	6 70									
12	24	3 80	4 15	4 50	4 95	5 95	6 10	6 50	7 10									
15	16	2 95	3 20	3 65	4 00	5 15	5 30	5 70	6 20	\$6 70								
15	18	3 15	3 45	3 90	4 30	5 55	5 70	6 10	6 50	7 15								
15	20	3 85	4 20	4 55	4 95	6 25	6 40	6 80	7 30	7 90								
15	22	4 10	4 45	4 85	5 25	6 50	6 65	7 05	7 50	8 10								
15	24	4 35	4 75	5 15	5 55	6 70	6 85	7 35	7 95	8 60								
18	18	3 55	3 85	4 40	4 75	6 20	6 35	6 75	7 25	7 90								
18	20	4 30	4 35	4 70	5 10	6 60	6 75	7 20	7 80	8 40								

Sketch with order, showing size and location of knock-outs and other features, will avoid errors and delays.

STEEL SERVICE AND CUT-OUT BOXES—Continued

HAND-FORMED CUT-OUT BOXES—Schedule O—Continued

The specifications and prices of special features given at the top of page 1083 apply to the boxes listed below.

PRICE LIST OF NO. 14 U. S. GAUGE STEEL BOXES

UNDERWRITERS' REQUIREMENTS { No dimension to exceed 40 inches  
 { No one surface to exceed 1000 square inches

Width Inches	Length Inches	DEPTH, INCHES									
		3	4	5	6	8	9	12	15	18	22
6	10	\$1 90	\$2 10	\$2 40	\$2 70	.....	.....	.....	.....	.....	.....
6	12	2 05	2 30	2 55	2 90	.....	.....	.....	.....	.....	.....
6	14	2 20	2 45	2 75	3 10	.....	.....	.....	.....	.....	.....
6	15	2 25	2 55	2 85	3 20	.....	.....	.....	.....	.....	.....
6	16	2 35	2 65	2 95	3 30	.....	.....	.....	.....	.....	.....
8	10	2 10	2 35	2 65	2 95	.....	.....	.....	.....	.....	.....
8	12	2 30	2 55	2 85	3 20	.....	.....	.....	.....	.....	.....
8	14	2 45	2 75	3 05	3 35	.....	.....	.....	.....	.....	.....
8	15	2 55	2 85	3 20	3 55	.....	.....	.....	.....	.....	.....
8	16	2 65	2 95	3 30	3 65	.....	.....	.....	.....	.....	.....
8	18	2 85	3 15	3 50	3 90	.....	.....	.....	.....	.....	.....
8	20	3 00	3 35	3 70	4 10	.....	.....	.....	.....	.....	.....
8	22	3 20	3 55	3 90	4 30	.....	.....	.....	.....	.....	.....
10	10	2 30	2 60	2 90	3 25	\$3 50	\$3 70	.....	.....	.....	.....
10	12	2 50	2 80	3 15	3 50	3 95	4 20	.....	.....	.....	.....
10	14	2 75	3 05	3 40	3 75	4 25	4 45	.....	.....	.....	.....
10	15	2 85	3 15	3 50	3 90	4 45	4 65	.....	.....	.....	.....
10	16	2 95	3 30	3 65	4 05	4 60	4 85	.....	.....	.....	.....
10	18	3 30	3 50	3 90	4 30	4 95	5 20	.....	.....	.....	.....
10	20	3 70	4 10	4 50	4 95	5 30	5 60	.....	.....	.....	.....
10	22	3 95	4 35	4 75	5 20	5 65	5 95	.....	.....	.....	.....
10	24	4 20	4 60	5 00	5 50	6 00	6 35	.....	.....	.....	.....
12	12	2 80	3 10	3 40	3 50	4 25	4 45	\$5 15	.....	.....	.....
12	15	3 15	3 45	3 85	4 15	4 85	5 10	5 85	.....	.....	.....
12	18	3 55	3 85	4 25	4 65	5 40	5 70	6 55	.....	.....	.....
12	22	4 35	4 75	5 20	5 65	6 25	6 55	7 50	.....	.....	.....
12	24	4 60	5 05	5 50	6 00	6 60	6 95	7 95	.....	.....	.....
12	27	5 15	5 60	6 05	6 55	7 20	7 60	8 65	.....	.....	.....
12	30	5 55	6 00	6 50	7 00	7 80	8 20	9 35	.....	.....	.....
15	15	3 60	3 95	4 35	4 75	5 50	5 80	6 60	\$7 45	.....	.....
15	18	4 05	4 40	4 80	5 25	6 15	6 45	7 40	8 30	.....	.....
15	22	5 00	5 40	5 85	6 35	7 05	7 40	8 40	9 55	.....	.....
15	24	5 30	5 75	6 20	6 70	7 50	7 85	8 95	10 05	.....	.....
15	27	5 90	6 35	6 80	7 50	8 15	8 55	9 75	10 90	.....	.....
15	30	6 35	6 80	7 30	7 85	8 85	9 25	10 50	11 80	.....	.....
15	33	6 75	7 30	7 85	8 40	9 55	10 00	11 75	12 60	.....	.....
15	36	7 25	7 75	8 80	8 90	10 20	10 70	12 05	13 45	.....	.....
18	18	4 55	4 95	5 40	5 85	6 90	7 20	8 25	9 25	\$10 90	\$12 20
18	21	5 55	5 85	6 35	6 85	7 65	8 00	9 10	10 15	11 90	13 45
18	24	6 10	6 40	6 95	7 45	8 35	8 80	9 95	11 10	12 90	14 45
18	27	6 45	7 10	7 60	8 15	9 15	10 00	10 80	12 05	13 90	15 50
18	30	7 10	7 65	8 15	8 75	9 90	10 30	11 60	12 95	14 90	16 65
18	33	7 65	8 40	8 60	9 35	10 65	11 10	12 55	13 90	15 90	17 75
18	36	8 15	9 70	9 35	9 95	11 40	11 90	13 35	14 85	16 90	18 85
21	21	6 05	6 50	7 05	7 55	8 45	8 80	10 00	11 15	12 95	14 45
21	24	6 60	7 15	7 65	8 20	9 25	9 70	10 95	12 15	14 05	15 75
21	27	7 20	7 85	8 65	8 95	10 10	10 55	11 85	13 15	15 10	16 85
21	30	7 90	8 45	9 05	9 60	10 95	11 40	12 80	14 20	16 20	18 00
21	33	8 50	9 05	9 15	10 25	11 30	12 25	13 75	15 20	17 25	19 20
21	36	9 10	9 70	10 30	12 00	12 60	13 15	14 65	16 40	18 30	20 35
24	24	7 25	7 90	8 45	9 05	10 15	10 60	11 95	13 25	15 15	17 20
24	27	7 85	8 60	9 15	9 75	11 05	11 55	12 95	14 30	16 30	18 15
24	30	8 70	9 25	9 85	10 50	12 00	12 45	14 00	14 45	17 50	19 40
24	33	9 40	10 00	10 55	11 55	12 90	13 40	15 00	16 50	18 60	20 60
24	36	10 05	10 65	11 25	11 90	13 80	14 35	15 55	17 20	19 35	21 45

Sketch with order, showing size and location of knock-outs and other features, will avoid errors and delays.

STEEL SERVICE AND CUT-OUT BOXES—Continued

HAND-FORMED CUT-OUT BOXES—Schedule O—Continued

The specifications and prices of special features given at the top of page 1083 apply to the boxes listed below.

PRICE LIST OF NO. 12 U. S. GAUGE STEEL BOXES

UNDERWRITERS' REQUIREMENTS (No dimension to exceed 60 inches. No one surface to exceed 1500 square inches)

Width Inches	Length Inches	DEPTH, INCHES									
		4	5	6	8	9	12	15	18	22	24
10	10	\$3 25	\$3 60	\$4 00	\$4 55	\$4 80	.....	.....	.....	.....	.....
10	12	3 50	3 90	4 30	5 10	5 35	.....	.....	.....	.....	.....
10	15	4 00	4 30	4 75	5 65	5 90	.....	.....	.....	.....	.....
10	18	4 30	4 75	5 25	6 25	6 55	.....	.....	.....	.....	.....
10	20	5 05	5 55	6 10	6 85	7 00	.....	.....	.....	.....	.....
10	24	5 65	6 20	6 45	7 55	7 90	.....	.....	.....	.....	.....
10	27	6 75	6 30	6 85	8 15	8 55	.....	.....	.....	.....	.....
10	30	6 20	6 75	7 35	8 80	9 25	.....	.....	.....	.....	.....
10	33	6 60	7 10	7 85	9 45	9 90	.....	.....	.....	.....	.....
10	36	7 05	7 65	8 30	10 10	10 65	.....	.....	.....	.....	.....
12	12	3 80	4 20	4 65	5 45	5 70	\$6 50	.....	.....	.....	.....
12	15	4 20	4 70	5 20	6 15	6 45	7 15	.....	.....	.....	.....
12	18	4 75	5 20	5 70	6 85	7 15	8 15	.....	.....	.....	.....
12	20	5 65	6 05	6 90	7 30	7 65	8 70	.....	.....	.....	.....
12	24	5 90	6 75	7 35	8 35	8 60	9 80	.....	.....	.....	.....
12	27	6 85	7 40	7 45	8 90	9 35	10 60	.....	.....	.....	.....
12	30	6 85	7 40	8 05	9 85	10 10	11 40	.....	.....	.....	.....
12	33	7 05	7 95	8 60	10 30	10 80	12 25	.....	.....	.....	.....
12	36	7 80	8 45	9 15	11 00	11 50	13 10	.....	.....	.....	.....
12	42	8 80	9 55	10 30	12 30	13 00	14 80	.....	.....	.....	.....
12	48	9 75	10 50	11 35	13 90	14 65	16 35	.....	.....	.....	.....
15	15	4 85	5 30	5 80	6 90	7 25	8 20	\$9 20	.....	.....	.....
15	18	5 40	5 90	6 40	7 70	8 05	9 05	10 20	.....	.....	.....
15	20	6 25	6 80	7 40	8 20	8 60	9 95	11 25	.....	.....	.....
15	24	6 95	7 60	8 25	9 25	9 70	10 95	12 20	.....	.....	.....
15	27	7 25	7 95	8 65	10 05	10 50	11 80	13 30	.....	.....	.....
15	30	7 80	8 45	9 10	10 85	11 30	12 70	14 30	.....	.....	.....
15	33	8 40	9 05	9 75	11 85	12 15	13 70	15 25	.....	.....	.....
15	36	8 95	9 65	10 35	12 40	13 00	14 60	16 25	.....	.....	.....
15	42	10 10	10 85	11 65	14 00	14 60	16 40	18 25	.....	.....	.....
15	48	11 35	12 05	12 85	15 50	16 20	18 25	20 25	.....	.....	.....
18	18	6 00	6 55	7 10	8 55	8 90	10 09	11 25	\$12 00	.....	.....
18	20	6 45	7 00	7 55	9 10	9 55	10 75	11 95	12 80	.....	.....
18	24	7 90	8 50	9 15	10 30	10 75	11 97	13 50	14 30	.....	.....
18	27	8 15	8 80	9 40	11 15	11 70	13 10	14 50	15 40	.....	.....
18	30	8 80	9 45	10 15	12 05	12 60	14 15	15 65	16 60	.....	.....
18	33	9 35	9 95	10 85	12 90	13 50	15 15	16 75	17 85	.....	.....
18	36	10 15	10 85	11 70	13 90	14 40	16 10	17 90	18 80	.....	.....
18	42	11 40	12 15	13 05	15 55	16 20	18 20	20 00	21 05	.....	.....
18	48	12 75	13 55	14 45	17 40	18 00	20 10	22 10	23 30	.....	.....
21	21	8 00	8 60	9 25	10 35	10 80	12 20	13 50	14 50	\$16 10	.....
21	24	8 75	9 35	10 05	11 30	11 80	13 30	14 70	15 55	17 45	.....
21	27	9 10	10 00	10 40	12 45	12 80	14 35	15 85	16 75	18 75	.....
21	30	9 80	10 50	11 45	13 30	13 80	15 45	17 10	18 00	20 20	.....
21	33	10 55	11 50	11 95	14 30	14 80	16 55	18 25	19 20	21 30	.....
21	36	11 85	11 95	12 80	15 30	15 80	17 80	19 45	20 45	22 80	.....
21	42	12 75	13 65	13 95	17 20	17 80	18 53	21 75	22 90	25 55	.....
21	48	14 20	15 00	14 50	19 10	19 80	21 60	24 15	25 30	28 15	.....
24	24	9 15	9 80	10 55	11 40	12 90	14 45	16 00	16 80	18 90	\$19 90
24	27	10 00	10 85	11 38	13 40	13 90	15 60	16 80	18 20	20 30	21 30
24	30	10 80	11 50	12 25	14 50	15 05	16 85	18 45	19 50	21 70	22 90
24	33	11 80	12 35	13 10	15 55	16 20	18 00	19 80	20 80	23 10	24 80
24	36	12 45	13 50	14 10	16 55	17 30	18 65	20 60	21 40	24 10	25 30
24	42	14 10	14 95	15 80	18 70	19 50	21 40	23 45	24 50	27 50	28 70
24	48	15 75	16 65	17 50	20 90	21 80	23 90	26 15	27 30	30 30	31 70

Sketch with order, showing size and location of knock-outs and other features, will avoid errors and delays.

STEEL SERVICE AND CUT-OUT BOXES—Continued

HAND-FORMED CUT-OUT BOXES—Schedule O—Continued

PRICE LIST OF NO. 10 U. S. GAUGE STEEL BOXES

The specifications and prices of special features given at the top of page 1083 apply to the boxes listed on this page.

NOTE.—Doors over 48 inches long will be provided with a substantial vault handle and three-way catch. Doors less than 48 inches long will be provided with galvanized commode catch unless otherwise specified.

The National Board of Fire Underwriters' U. S. gauge steel for all boxes having any dimensions over 60 inches and any surface over 1500 square inches.

Width Length		DEPTH, INCHES							
Inches	Inches	4	6	9	12	15	18	22	24
10	11	\$4 50	\$5 55	\$6 05	.....	.....	.....	.....	.....
10	12	4 70	6 00	6 80	.....	.....	.....	.....	.....
10	15	5 55	6 40	7 45	.....	.....	.....	.....	.....
10	18	6 00	7 30	8 30	.....	.....	.....	.....	.....
10	21	6 60	8 70	9 50	.....	.....	.....	.....	.....
10	24	7 85	9 35	10 00	.....	.....	.....	.....	.....
10	27	8 45	10 05	10 90	.....	.....	.....	.....	.....
10	30	9 10	10 75	11 75	.....	.....	.....	.....	.....
10	33	9 70	11 50	12 55	.....	.....	.....	.....	.....
10	36	10 30	12 15	13 40	.....	.....	.....	.....	.....
12	12	5 30	6 45	7 20	\$8 30	.....	.....	.....	.....
12	15	5 95	7 30	8 15	9 40	.....	.....	.....	.....
12	18	6 60	7 90	9 05	10 50	.....	.....	.....	.....
12	21	7 95	9 55	10 15	11 60	.....	.....	.....	.....
12	24	8 60	10 20	10 95	12 75	.....	.....	.....	.....
12	27	9 30	11 00	12 10	13 75	.....	.....	.....	.....
12	30	10 00	11 75	12 80	14 85	.....	.....	.....	.....
12	36	11 40	13 30	15 00	17 05	.....	.....	.....	.....
12	42	12 85	14 95	16 95	19 30	.....	.....	.....	.....
12	48	14 15	16 40	18 90	21 60	.....	.....	.....	.....
15	15	6 70	8 05	9 05	10 55	\$11 80	.....	.....	.....
15	18	7 55	8 90	10 35	11 75	13 20	.....	.....	.....
15	21	7 65	10 60	11 45	13 00	14 60	.....	.....	.....
15	24	8 25	11 50	12 55	14 20	15 95	.....	.....	.....
15	27	10 65	12 30	13 60	15 45	17 30	.....	.....	.....
15	30	11 40	13 20	14 70	16 65	18 65	.....	.....	.....
15	36	13 05	15 00	16 90	19 10	21 30	.....	.....	.....
15	42	14 65	16 75	20 10	21 40	24 00	.....	.....	.....
15	48	16 30	18 55	21 30	24 00	26 70	.....	.....	.....
18	18	8 40	9 85	11 50	12 95	14 60	\$16 95	.....	.....
18	21	10 05	11 70	12 70	14 45	15 65	18 10	.....	.....
18	24	10 95	12 75	13 95	15 75	17 60	19 70	.....	.....
18	27	11 85	13 75	15 50	17 10	19 05	21 25	.....	.....
18	30	12 80	14 75	16 40	18 50	20 55	22 85	.....	.....
18	36	14 80	16 80	19 15	21 10	23 50	26 05	.....	.....
18	42	16 55	18 85	21 25	23 80	26 45	39 25	.....	.....
18	48	18 40	20 80	23 50	26 50	29 35	32 45	.....	.....
18	54	21 80	24 40	31 35	34 75	39 15	42 50	.....	.....
21	21	11 10	12 85	14 00	15 85	17 65	19 75	\$22 20	.....
21	24	12 15	13 95	15 40	17 35	19 30	21 45	24 10	.....
21	27	13 20	15 10	16 70	18 80	20 85	23 20	26 95	.....
21	30	14 25	16 20	18 05	20 30	22 45	24 95	27 80	.....
21	36	16 35	18 50	20 80	23 20	25 60	28 35	31 60	.....
21	42	18 40	20 75	23 45	26 20	28 90	31 80	35 40	.....
21	48	20 35	23 90	26 20	29 05	32 05	35 25	39 15	.....
21	54	24 20	26 90	33 15	37 50	41 45	45 50	45 95	.....
21	60	26 40	29 20	35 90	40 50	44 65	48 90	54 90	.....
21	66	27 55	31 55	38 70	43 50	47 80	52 40	58 65	.....
21	72	29 70	33 90	41 50	46 50	51 00	55 90	62 40	.....
24	24	13 30	15 20	16 85	18 90	21 00	23 30	26 00	\$27 40
24	27	14 45	16 45	18 30	20 50	22 50	25 10	28 05	29 55
24	30	15 85	17 80	19 75	22 10	24 50	26 95	30 05	31 65
24	36	17 95	20 20	22 70	24 60	27 20	29 95	33 35	35 15
24	42	20 30	22 75	25 50	28 40	31 30	33 70	38 05	39 95
24	48	22 55	24 20	28 55	31 45	35 75	38 40	42 05	44 15
24	54	26 15	29 30	35 30	39 00	42 30	46 00	50 80	53 15
24	60	29 50	31 90	38 30	42 25	45 90	49 70	54 85	57 40
24	66	31 90	34 55	41 30	45 50	49 30	53 40	58 85	61 55
24	72	34 20	37 10	44 30	48 75	52 80	56 90	62 90	65 80

TYPE L CUT-OUT BOXES

A first-class installation calls for a high-grade cut-out box with a door secured to a matt or trim which is fastened to the front flanges of the box. This construction insures perfect fitting doors on large cut-out boxes.

Prices below apply to cut-out boxes having trims and doors. The following prices apply only to boxes with single doors. Made of No. 10 U. S. gauge steel.

Width Length		DEPTH, INCHES							
Inches	Inches	4	6	9	12	15	18	22	24
18	54	\$27 45	\$30 45	\$40 45	\$43 15	\$45 85	\$48 95	\$54 95	\$57 95
21	54	30 30	33 45	38 10	43 05	47 65	52 35	58 55	61 75
21	60	32 85	36 15	41 10	46 15	51 45	56 15	62 55	66 15
21	66	34 40	38 65	44 05	49 45	54 95	60 10	67 10	70 85
21	72	37 95	41 70	47 25	52 75	58 55	64 05	71 45	75 05
24	54	33 60	36 40	40 45	44 55	48 65	53 90	58 15	60 95
24	60	36 55	39 30	43 70	48 05	52 60	57 00	62 85	65 70
24	66	39 30	42 45	46 95	51 65	56 55	61 15	67 35	70 45
24	72	42 15	45 45	50 45	55 35	60 45	65 25	71 95	75 25

Surface type L boxes will be furnished unless otherwise specified. Flush type L boxes will be furnished when so ordered at the same prices.

Sketch with order, showing size and location of knock-outs and other features, will avoid errors and delays.

STEEL SERVICE AND CUT-OUT BOXES—Continued

HAND-FORMED CUT-OUT BOXES—Schedule O—Continued

**Flush Type Cut-out Boxes** will be furnished when so ordered at an addition of 50 per cent to the list prices given on pages 1083, 1084, 1085 and 1086, not including type L boxes listed on page 1086. This price applies only to boxes having the door opening the same size as the box. For flush cut-out boxes with door opening smaller than the box, add 75 per cent to list price.

The standard finish of flush cut-out boxes is a high grade black enamel.

For white enamel finish add \$1.00 list per square foot area of trim and door.

**Steel Barriers** forming gutters around an open space in the center of the cut-out box will be provided with surface type or flush type boxes listed on pages 1083, 1084, 1085 and 1086 for 100 per cent additional to list prices.

**Steel Barriers** will be furnished securely riveted to the back of the box, and arranged to allow a wide vein pocket or raceway around the center section of the box. Knock-outs for the accommodation of 1/2-inch steel or porcelain bushings will be provided in all barriers. All boxes are provided with standard 1/8-inch knock-outs for 1/2-inch conduit pipe.

**NOTE A.**—When ordering cut-out boxes with steel barriers specify size of cabinet and width of gutter desired—rather than the dimensions of the space required for wiring devices. Prices are based on size of cabinet and not on size of space for wiring devices.

**Underwriters' requirements for cut-out boxes containing devices controlling more than four circuits:**

**Wire Compartments**

**NOTE B.**—Cabinets and cut-out boxes, when used to enclose devices or apparatus connected within the cabinet or cut-out box to the wires of more than four circuits, not including the supply circuit or a continuation thereof, must have back wiring spaces or one or more side wiring spaces, side gutters or wiring compartments unless the wires leave the cabinet or cut-out box directly opposite their terminal connections.

**Barriers**

Cabinets or cut-out boxes having one or more side wiring spaces, side gutters or side wiring compartments must be furnished with covers, barriers or partitions extending around, or from the side or sides of all bases or groups of bases of the switches, cut-outs, circuit-breakers or feeder and circuit branch panelboards within the cabinet or cut-out box and providing a close fit with the door, frame or side walls so as to enclose these spaces, gutters or compartments and the wires stowed within them. At sides where wires or cables are led from the cabinet or cut-out box at points directly opposite their terminal connections to devices or apparatus within the cabinet or cut-out box and other wires or cables are not placed, these covers, barriers or partitions may be omitted.

Porcelain bushings will be furnished for cut-out boxes at the following list prices per bushing:

No. 1 Internal diameter 1/4 inches for No. 12 DBRC Solid Wire.....	\$0	07
No. 2 Internal diameter 3/8 inches for No. 8 DBRC Solid Wire.....		08
No. 3 Internal diameter 1/2 inches for No. 3 DBRC Stranded Wire.....		09
No. 4 Internal diameter 3/4 inches for No. 00 DBRC Stranded Wire.....		12
No. 5 Internal diameter 1 1/4 inches 450,000 CM cable.....		14
No. 6 Internal diameter 1 3/4 inches 1,000,000 CM cable.....		24

**Extended Cover Pull Boxes**

Extended cover pull boxes with cover fastened on with machine screws are easy to install and afford all the space required to make splices, taps, or bends, without the inconvenience of working in a deep box. The box proper is made of sufficient depth to accommodate only the conduit connected to the box. This provides an open space for pulling in heavy cables without drawing them over the edge of a deeper box. This feature saves time and labor and eliminates abrasion of the insulation. When all connections have been made, the extended cover is put on and completely incloses all cables.

List prices include any number of one size of knock-outs up to 3-inch conduit pipe. Add 10 cents list in each box for each change of knock-outs not larger than for 3-inch conduit. For larger holes add 25 cents list per hole.

Cover—3 to 6 inches deep No. 14 U. S. gauge steel.

Box—3 to 6 inches deep No. 14 U. S. gauge steel.

For No. 12 U. S. gauge steel add 20 per cent.

For No. 10 U. S. gauge steel add 45 per cent.

Prices for sizes not listed will be quoted upon receipt of full details.

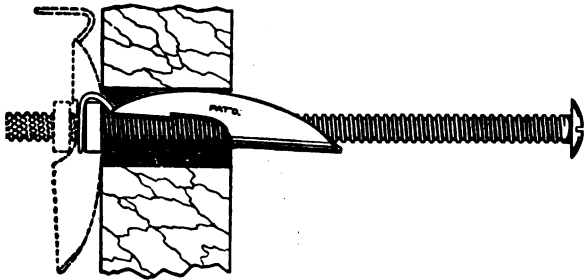


EXTENDED COVER PULL BOX

Length Inches	Width Inches	List Price	Length Inches	Width Inches	List Price
12	12	\$ 6 70	18	24	\$13 10
12	15	7 80	21	21	12 10
12	18	8 75	21	24	14 30
15	15	8 75	21	27	17 20
15	18	9 90	24	24	18 00
18	18	10 75	24	27	18 85
18	21	11 95	24	30	20 00

# TOGGLE BOLTS

## SCHEDULE O—STANDARD PACKAGE QUANTITY 1000



Unequaled for securing molding, brackets, telephones or any fixtures to walls or ceilings on which screws will not hold, such as tile, metal or marble.

Can be used with the nut or thread outside; or with the nut inside, exposing only the slotted head of the bolt. Easy to put up. Simply bore or chip a hole ( $\frac{1}{2}$  inch is large enough for the  $\frac{3}{8}$ -inch size, but the toggle holds firmly even in a  $\frac{3}{4}$  or 1-inch hole). Insert the toggle as per illustration till the

loose bar drops; then pull back and turn the bolt (or nut) till it binds the work.

Has no tiny rivet to limit its strength, hence the regular size (with  $\frac{3}{8}$ -inch shank) is as strong as the  $\frac{3}{8}$ -inch old style toggle bolt. Adapts itself to fastening objects of varying thicknesses, the 4-inch size meeting most needs.

Made in four sizes: Regular ( $\frac{3}{8}$ -inch shank); slender ( $\frac{1}{8}$ -inch); quarter-inch and Jumbo ( $\frac{3}{4}$ -inch).



OFFSET IRON HEAD

Size Inches	Style No.	List Price per 100	Size Inches	Style No.	List Price per 100
$\frac{1}{8}$ x3	W23911	\$3 40	$\frac{1}{4}$ x3	W23910	\$5 60
$\frac{1}{4}$ x4	W23912	3 80	$\frac{1}{4}$ x4	W23917	8 00
$\frac{3}{8}$ x6	W23913	4 40	$\frac{1}{4}$ x5	W23918	7 00
$\frac{1}{2}$ x3	W23914	3 60	$\frac{1}{2}$ x4	W23919	8 00
$\frac{1}{2}$ x4	W23915	4 00	$\frac{1}{2}$ x6	W23920	10 00
$\frac{1}{2}$ x6	W23916	5 00			

\*For plain brass heads, deduct \$1.00 list.



## WESTINGHOUSE TAPES

A Grade for Every Requirement and Each Grade Always Uniform in Quality



### Friction Tape

The two important uses of friction tape are to furnish mechanical protection and to furnish electrical protection to electric wires. On circuits of very low voltage, friction tape alone is used; on wires of higher voltage the friction tape serves not so much to insulate the wire as to protect the inner wrappings of treated cloth or splicing compound.

The principal requirements of friction tape are: **Durability**, or the ability to retain fixed qualities under conditions of climate, heat or moisture in which it must be used; **Adhesiveness**, or the ability to adhere firmly where applied; and **Yardage**. Covering power is purchased rather than weight, therefore other characteristics being fairly equal, the tape of higher yardage is the most economical to use.

Westinghouse Friction Tapes have all of these characteristics in the highest degree.

### Splicing Compound

Splicing compound is a tape made from pure rubber, so treated that it has permanent dielectric and mechanical strength and adhesiveness.

It is used for high voltage insulation and when

wound on a joint or splice should form a solid tube, allowing for the greatest possible dielectric strength at the joint and making a positive seal against water.

Perfect results are obtained with Westinghouse Splicing Compounds.

### Cable Tape

Cable Tape is recommended for the most severe service where perfect and permanent protection is required. This is a perfect insulator and is water-proof and acid-proof.



### A Grade for Each Requirement

**Westinghouse Friction Tape, Straight and Bias**—For all service where highest quality is required.

**I. X. L. Friction Tape**—For motor or generator work and interior wiring. Has extremely high yardage.

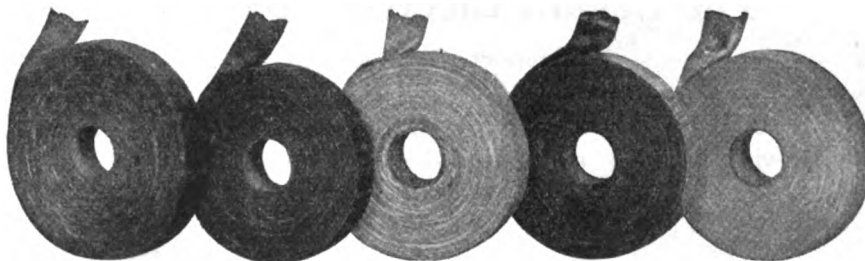
**Adhere Friction Tape**—For general requirements.

**Westinghouse Special Splicing Compound**—For severe service where best rubber tape is required.

**Pittsburgh Splicing Compound**—For general use where service conditions are not severe or where a low-priced rubber tape is desired.

**Westinghouse Cable Tape**—For high voltage line work, in mines and subways or where conditions of moisture are very severe.

**Armature Tape**—A high grade white tape, frictioned on one side only for insulation on armature coils.



ADHERE TAPE I. X. L. TAPE WESTINGHOUSE TAPE WESTINGHOUSE SPLICING COMPOUND PITTSBURGH SPLICING COMPOUND

# BRYANT WIRING DEVICES

*The most complete line of  
wiring devices*

## Sockets

There is a Bryant socket for every possible use: brass shell sockets, porcelain sockets, composition sockets.

## Receptacles

Bryant makes a receptacle for every purpose and of every practical design and material.

## Switches

Bryant surface and flush switches are made in rotary, push, pull and toggle types for nearly every conceivable purpose in connection with interior wiring.



*You need the Bryant Catalogue  
Ask for it, it is free*

## The Bryant Electric Company

Bridgeport, Connecticut

**NEW YORK**

342 Madison Ave.

**CHICAGO**

844 W. Adams St.

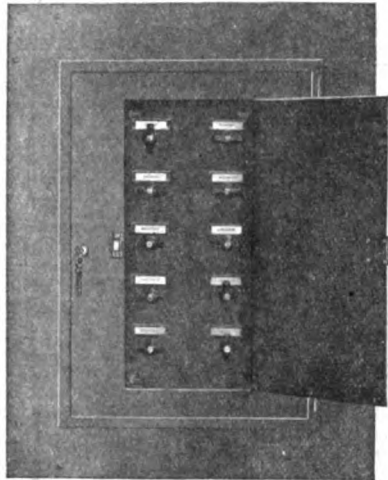
**SAN FRANCISCO**

149 New Montgomery St.

## TYPE S SAFETY PANEL BOARDS

### DEAD-FRONT—HEAVY-DUTY SWITCH

**For Capacities up to 200 Amperes, and for Voltages up to 250**  
**30-Ampere Branches**



TYPE S SAFETY PANEL BOARD

#### Application

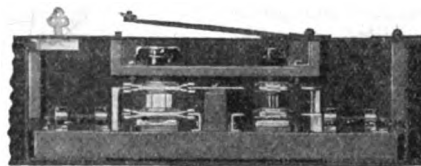
Type S safety panel boards were developed to supply the existing demand for electrical devices that can be safely handled by persons inexperienced in the use of such apparatus. Panel boards for the control of lighting circuits are essentially in this class of apparatus, due to their application in private houses, apartment houses, stores, factories, etc.

Since the introduction of these panel boards the demand for safety apparatus has greatly increased, especially in the applications on lower voltages

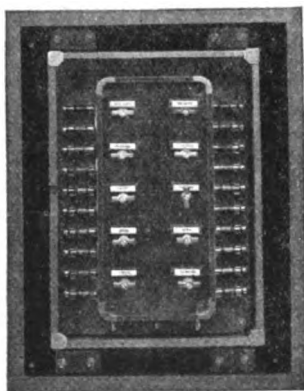
which are ordinarily considered not dangerous. This demand is featured by the Safety Code adopted by the United States Department of Commerce, Bureau of Standards, and by the various state Safety Codes.

Type S panel boards are standardized in such form as to make them applicable wherever the standard form of live-face panel board has heretofore been applied.

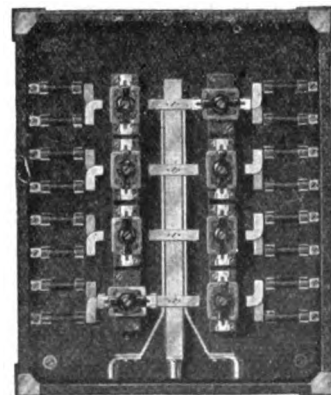
Type S safety panel boards have been approved by the Underwriters' Laboratories, for 30-ampere 250-volt branches.



HORIZONTAL SECTION THROUGH SAFETY  
PANEL BOARD



SAFETY PANEL BOARD IN STEEL BOX  
WITHOUT TRIM OR DOOR



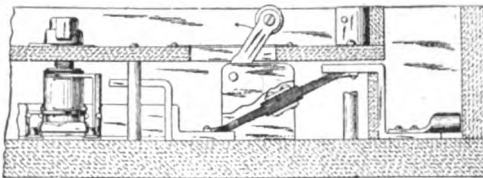
SAFETY PANEL BOARD WITH PRO-  
TECTING COVER REMOVED

## TYPE S DEAD-FRONT SAFETY PANEL BOARDS—Continued

**Distinctive Features**

The following distinctive features apply to the type S safety panel boards.

100 per cent safety to the operator in the ordinary operation of branch or main switches; fuses in separate locked compartment; all branch switches are of quick-make and quick-break snap switch type, of extra heavy construction and large capacity; main switches, where used, of the quick-break brush-type construction; especially good appearance of panels, cabinets, and trims.



SECTION OF SAFETY PANEL BOARD WITH SAFETY BRUSH TYPE MAIN SWITCH

**Operating Characteristics**

In the construction of these panel boards the branch switches, and, when used, the main switches are covered by a safety cover of  $\frac{3}{8}$ -inch slate with only the operating handles of the switches projecting through this cover. A  $\frac{3}{8}$ -inch slate frame surrounds the cover forming a separate safety compartment for the switch handles covered by a steel door provided with a catch. The fuse holders are mounted on the base outside of the safety frame, and are covered by a steel door. This door over the fuse compartment is provided with a Yale lock, thus preventing any but authorized persons from having access to the fuse compartment.

In the operation of the branch switches the quick-make and quick-break features make it impossible for a careless operator to leave a switch only partly closed, and the extra heavy construction of these switches provides for an extra long life without the necessity of renewing parts.

The main switch, when provided, is of the standard brush type, and operates as a quick-break switch, the break being independent of the operating handle, thus insuring against any excessive burning of the contacts due to careless operation.

**Construction**

Type S safety panel boards are regularly sold only as complete boards with enclosing cabinets, since only in this way can the safety provisions be properly insured.

**General Specifications**—The specifications for these safety panel boards are as follows:

- Base**—1-inch black slate.
- Frame**— $\frac{1}{4}$ -inch black slate slotted for mains and branches. Held together by dull black finished corners, which conceal all joints of frame.
- Safety Cover**— $\frac{3}{8}$ -inch black slate surrounded by  $\frac{3}{8}$ -inch black slate frame held by dull black finished corner pieces.
- Card Holder**—Dull black finish. One for each circuit.
- Corner Iron**— $\frac{1}{2}$ -inch steel with round corners, clamping slate frame and corner pieces by one screw.
- Gutter**— $3\frac{1}{4}$ -inch; add  $6\frac{1}{4}$  inches to panel size to get inside size of box. Standard gutters  $3\frac{1}{4}$  inches, 4 inches,  $4\frac{1}{4}$  inches,  $5\frac{1}{4}$  inches.

- Bus-bars**—98% conductivity drawn copper.
- Clips**—98% conductivity drawn copper one piece.
- Branch Bars**—98% conductivity drawn copper one piece.
- Terminal Lugs**—98% conductivity drawn copper; no castings used.

**Current Density and Spacings**—As per rules and regulations of the National Board of Fire Underwriters.

- Capacity**—Mains are figured:
  - 3 amperes per circuit for 3-2 wire 125 volts.
  - 6 amperes per circuit for 2-2 wire 125 volts.
  - 3 amperes per circuit for 2-2 wire 250 volts.
 Mains of larger capacity can be furnished at additional cost.

**Branch Circuit Terminals**—Provided with special washers confining and retaining the wires.

**Branch Circuit Switches**—Special 30-amp. snap switches. Absolutely strongest panel switch on the market.

**Fuse Arrangement**—N. E. C. with phosphor-bronze clips. Edison plug with black-enameled porcelain shell.

**Main and Feeder Switches**—Safety brush switches, quick-break, double-break.

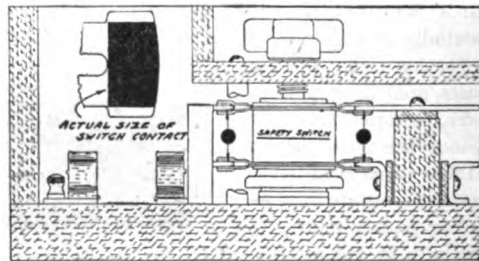
**Cabinets**—Sheet steel standard code thickness. Panels are held in position by four adjustable clamps, each held to the box by two screws. Weight of panels is supported on angle iron, riveted to box. Boxes are dull black finish.

**Doors and Trims**—Doors are equipped with Yale lock on fuse compartment and catch over switch compartment.

Steel trims are of Standard code thickness with concealed hinges and dull black finish.

**Special boxes and panels with marble bases can be furnished on special order—prices on request.**

**Main Switches**—The main switches, when used, are of the Standard brush-type construction with galvanized steel toggle mechanism. They are quick-break and double-break, and are provided with arcing tips at each end. They are of ample capacity to stand much heavier than the current for which they are rated. These switches are removable as a unit, and interchangeable. They may be placed under a separate door on special order.



SECTION OF SAFETY PANEL SHOWING SIZE OF SAFETY SWITCH CONTACT, WHICH IS SEVERAL TIMES THAT OF THE USUAL SNAP OR PUSH BUTTON ORDINARILY USED IN SAFETY PANEL CONSTRUCTION

**Branch Switches**—The branch switches used on these panels are a special feature, as they consist of double-pole, double-break snap switches of extra large size and ruggedness of design. The contacts have ample carrying and interrupting capacity to handle 30 amperes continuously. These switches are both quick-make and quick-break, and are mounted upon individual steel bases, making the complete unit easily replaceable. In assembly of the panel the individual switches are firmly fastened to a continuous steel base providing absolute insurance against their getting out of alignment.

TYPE S DEAD-FRONT SAFETY PANEL BOARDS—Continued

Mains—With terminal lugs only.  
 Branches—Two-wire with special 30-ampere snap switches arranged for N. E. C. enclosed fuses.

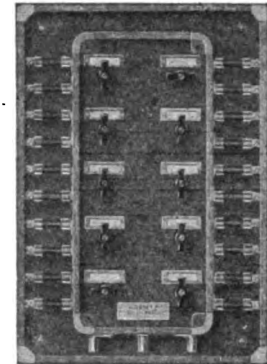
CABINETS

Style FS—Flush steel box and steel trim.  
 Style SS—Surface steel box and steel trim.  
 For inside dimensions of box add 6½ inches to panel size for ¾-inch gutter.  
 Through-feed panels and mains of larger capacity can be furnished at additional cost.

Style number and list price do not include fuses.  
 Boxes will be drilled for conduit without extra charge provided complete drilling information accompanies order. Boxes will be shipped undrilled unless templates are sent with order showing location and sizes of holes wanted.

Knockouts for one half of the total number of circuits will be furnished without additional charge when requested on the initial order. Extra knockouts will be furnished at 10c each, list.

For panels with fuses in the mains add 8 per cent to list price of panel.  
 Panels with three-way switches can be furnished at an additional coast.



TYPE S PANEL BOARDS COMPLETE WITH CABINET

Amps. Capacity of Mains	OUTSIDE DIMENSIONS OF PANELS IN INCHES			Approx. Shipping Wt., Lbs.	Number of Circuits	STYLE NUMBERS		List Price
	Height	Width	Depth			N. E. C. Fuses Style FS	Style SS	
<b>2-Wire Mains</b>								
<b>125 Volts</b>								
30	11 ½	14 ½	4 ½	125	4	K-38254	Double Branch K-38270	\$ 91 00
60	14 ½	14 ½	4 ½	140	6	K-38255	K-38271	107 00
60	17 ½	14 ½	4 ½	155	8	K-38256	K-38272	128 00
60	20 ½	14 ½	4 ½	170	10	K-38257	K-38273	148 00
100	23 ½	14 ½	4 ½	185	12	K-38258	K-38274	168 00
100	26 ½	14 ½	4 ½	200	14	K-38259	K-38275	188 00
160	29 ½	14 ½	4 ½	210	16	K-38260	K-38276	208 00
200	35 ½	14 ½	4 ½	225	18	K-38261	K-38277	228 00
200	38 ½	14 ½	4 ½	235	20	K-38262	K-38278	250 00
200	41 ½	14 ½	4 ½	250	22	K-38263	K-38279	272 00
200	44 ½	14 ½	4 ½	265	24	K-38264	K-38280	296 00
200	47 ½	14 ½	4 ½	290	26	K-38265	K-38281	318 00
200	50 ½	14 ½	4 ½	310	28	K-38266	K-38282	340 00
200	53 ½	14 ½	4 ½	325	30	K-38267	K-38283	366 00
200	56 ½	14 ½	4 ½	340	32	K-38268	K-38284	390 00
<b>3-Wire Mains</b>								
<b>125 Volts</b>								
30	11 ½	14 ½	4 ½	125	4	K-38350	Double Branch K-38366	91 00
30	14 ½	14 ½	4 ½	140	6	K-38351	K-38367	107 00
30	17 ½	14 ½	4 ½	155	8	K-38352	K-38368	128 00
30	20 ½	14 ½	4 ½	170	10	K-38353	K-38369	148 00
60	23 ½	14 ½	4 ½	185	12	K-38354	K-38370	168 00
60	26 ½	14 ½	4 ½	200	14	K-38355	K-38371	188 00
60	29 ½	14 ½	4 ½	210	16	K-38356	K-38372	208 00
60	32 ½	14 ½	4 ½	225	18	K-38357	K-38373	228 00
60	35 ½	14 ½	4 ½	235	20	K-38358	K-38374	250 00
100	38 ½	14 ½	4 ½	250	22	K-38359	K-38375	272 00
100	41 ½	14 ½	4 ½	265	24	K-38360	K-38376	296 00
100	44 ½	14 ½	4 ½	280	26	K-38361	K-38377	318 00
100	47 ½	14 ½	4 ½	310	28	K-38362	K-38378	340 00
100	50 ½	14 ½	4 ½	325	30	K-38363	K-38379	366 00
100	53 ½	14 ½	4 ½	340	32	K-38364	K-38380	390 00
<b>2-Wire Mains</b>								
<b>250 Volts</b>								
30	11 ½	14 ½	4 ½	125	4	K-38446	Double Branch K-38462	100 00
30	14 ½	14 ½	4 ½	140	6	K-38447	K-38463	119 00
30	17 ½	14 ½	4 ½	155	8	K-38448	K-38464	142 00
30	20 ½	14 ½	4 ½	170	10	K-38449	K-38465	164 00
60	23 ½	14 ½	4 ½	185	12	K-38450	K-38466	186 00
60	26 ½	14 ½	4 ½	200	14	K-38451	K-38467	208 00
60	29 ½	14 ½	4 ½	210	16	K-38452	K-38468	228 00
60	32 ½	14 ½	4 ½	225	18	K-38453	K-38469	252 00
60	35 ½	14 ½	4 ½	235	20	K-38454	K-38470	276 00
100	38 ½	14 ½	4 ½	250	22	K-38455	K-38471	298 00
100	41 ½	14 ½	4 ½	265	24	K-38456	K-38472	324 00
100	44 ½	14 ½	4 ½	280	26	K-38457	K-38473	347 00
100	47 ½	14 ½	4 ½	310	28	K-38458	K-38474	375 00
100	50 ½	14 ½	4 ½	325	30	K-38459	K-38475	402 00
100	53 ½	14 ½	4 ½	340	32	K-38460	K-38476	428 00

Data sheet, form 7586, will be of valuable assistance in ordering.

Order by Style Number

**TYPE S DEAD-FRONT SAFETY PANEL BOARDS—Continued**

**Mains**—With unfused safety brush switch.

**Branches**—Two-wire with special 30-ampere snap switches arranged for N. E. C. enclosed fuses.

**CABINETS**

**Style FS**—Flush steel box and steel trim.

**Style SS**—Surface steel box and steel trim.

For inside dimensions of box add 6½ inches to panel size for ¾-inch gutter.

Through-feed panels and mains of larger capacity can be furnished at additional cost.

**Style number and list price do not include fuses.**

Boxes will be drilled for conduit without extra charge provided complete drilling information accompanies order. Boxes will be shipped undrilled unless templates are sent with order showing location and sizes of holes wanted.

Knockouts for one half of the total number of circuits will be furnished without additional charge when requested on the initial order. Extra knockouts will be furnished at 10c each, list.

For panels with fuses in the mains add 4 per cent to list price of panel.

Panels with three-way switches can be furnished at an additional cost.



**TYPE S PANEL BOARDS COMPLETE WITH CABINET**

Amps. Capacity of Mains	OUTSIDE DIMENSIONS OF PANELS IN INCHES			Approx. Shipping Wt., Lbs.	Number of Circuits	STYLE NUMBERS		List Price
	Height	Width	Depth			N. E. C. Fuses	Style FS	
<b>125 Volts</b>								
<b>2-Wire Mains</b>								
30	19	14 1/2	4 1/2	150	4	K-38542	Double Branch K-38558	\$148 00
60	22	14 1/2	4 1/2	170	6	K-38543	K-38559	182 00
60	25	14 1/2	4 1/2	190	8	K-38544	K-38560	183 00
60	28	14 1/2	4 1/2	205	10	K-38545	K-38561	201 00
100	31	14 1/2	4 1/2	225	12	K-38546	K-38562	223 00
100	34	14 1/2	4 1/2	240	14	K-38547	K-38563	245 00
100	37	14 1/2	4 1/2	250	16	K-38548	K-38564	267 00
200	44 1/2	14 1/2	4 1/2	270	18	K-38549	K-38565	291 00
200	47 1/2	14 1/2	4 1/2	280	20	K-38550	K-38566	309 00
200	50 1/2	14 1/2	4 1/2	300	22	K-38551	K-38567	338 00
200	53 1/2	14 1/2	4 1/2	320	24	K-38552	K-38568	353 00
200	56 1/2	14 1/2	4 1/2	340	26	K-38553	K-38569	370 00
200	59 1/2	14 1/2	4 1/2	375	28	K-38554	K-38570	396 00
200	62 1/2	14 1/2	4 1/2	390	30	K-38555	K-38571	416 00
200	65 1/2	14 1/2	4 1/2	410	32	K-38556	K-38572	439 00
<b>125 Volts</b>								
<b>3-Wire Mains</b>								
30	19	14 1/2	4 1/2	150	4	K-38638	Double Branch K-38654	148 00
30	22	14 1/2	4 1/2	170	6	K-38639	K-38655	182 00
30	25	14 1/2	4 1/2	190	8	K-38640	K-38656	183 00
30	28	14 1/2	4 1/2	205	10	K-38641	K-38657	201 00
60	31	14 1/2	4 1/2	225	12	K-38642	K-38658	223 00
60	34	14 1/2	4 1/2	240	14	K-38643	K-38659	245 00
60	37	14 1/2	4 1/2	250	16	K-38644	K-38660	267 00
60	40	14 1/2	4 1/2	270	18	K-38645	K-38661	291 00
60	43	14 1/2	4 1/2	280	20	K-38646	K-38662	309 00
100	46	14 1/2	4 1/2	300	22	K-38647	K-38663	338 00
100	49	14 1/2	4 1/2	320	24	K-38648	K-38664	353 00
100	52	14 1/2	4 1/2	340	26	K-38649	K-38665	370 00
100	55	14 1/2	4 1/2	375	28	K-38650	K-38666	396 00
100	58	14 1/2	4 1/2	390	30	K-38651	K-38667	416 00
100	61	14 1/2	4 1/2	410	32	K-38652	K-38668	439 00
<b>250 Volts</b>								
<b>2-Wire Mains</b>								
30	19	14 1/2	4 1/2	150	4	K-38734	Double Branch K-38750	182 00
30	22	14 1/2	4 1/2	170	6	K-38735	K-38751	181 00
30	25	14 1/2	4 1/2	190	8	K-38736	K-38752	201 00
30	28	14 1/2	4 1/2	205	10	K-38737	K-38753	223 00
60	31	14 1/2	4 1/2	225	12	K-38738	K-38754	245 00
60	34	14 1/2	4 1/2	240	14	K-38739	K-38755	269 00
60	37	14 1/2	4 1/2	250	16	K-38740	K-38756	294 00
60	40	14 1/2	4 1/2	270	18	K-38741	K-38757	322 00
60	43	14 1/2	4 1/2	280	20	K-38742	K-38758	340 00
100	46	14 1/2	4 1/2	300	22	K-38743	K-38759	371 00
100	49	14 1/2	4 1/2	320	24	K-38744	K-38760	388 00
100	52	14 1/2	4 1/2	340	26	K-38745	K-38761	405 00
100	55	14 1/2	4 1/2	375	28	K-38746	K-38762	439 00
100	58	14 1/2	4 1/2	390	30	K-33747	K-38763	459 00
100	61	14 1/2	4 1/2	410	32	L-38748	K-38764	482 00

Data sheet, form 7586, will be of valuable assistance in ordering.

**Order by Style Number**

TYPE S DEAD-FRONT SAFETY PANEL BOARDS—Continued

Mains—With terminal lugs only.

Branches—Two-wire with special 30-ampere snap switches arranged for plug fuses.

CABINETS

Style FS—Flush steel box and steel trim.

Style SS—Surface steel box and steel trim.

For inside dimensions of box add 6½ inches to panel size for ¾-inch gutter.

Through-feed panels and mains of larger capacity can be furnished at an additional cost.

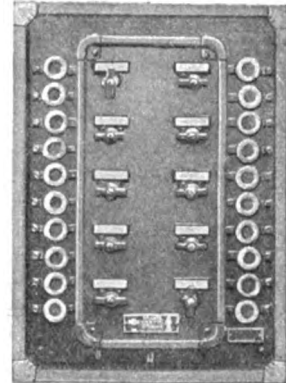
Style number and list price do not include fuses.

Boxes will be drilled for conduit without extra charge provided complete drilling information accompanies order. Boxes will be shipped undrilled unless templates are sent with order showing location and sizes of holes wanted.

Knockouts for one half of the total number of circuits will be furnished without additional charge when requested on the initial order. Extra knockouts will be furnished at 10c each, list.

For panels with fuses in the mains add 8 per cent to list price of panel.

Panels with three-way switches can be furnished at an additional cost.



TYPE S PANEL BOARDS COMPLETE WITH CABINET

Amps. Capacity of Mains	OUTSIDE DIMENSIONS OF PANELS IN INCHES			Approx. Shipping Wt. Lbs.	Number of Circuits	STYLE NUMBERS		List Price	
	Height	Width	Depth			PLUG FUSES Style FS	Style SS		
<b>2-Wire Mains</b>									
<b>125 Volts</b>									
30	11 ½	14 ½	4 ½	125	4	K-38222	K-38238	\$ 86 00	
60	14 ½	14 ½	4 ½	140	6	K-38223	K-38239	102 00	
60	17 ½	14 ½	4 ½	155	8	K-38224	K-38240	124 00	
60	20 ½	14 ½	4 ½	170	10	K-38225	K-38241	142 00	
100	23 ½	14 ½	4 ½	185	12	K-38226	K-38242	162 00	
100	26 ½	14 ½	4 ½	200	14	K-38227	K-38243	183 00	
100	29 ½	14 ½	4 ½	210	16	K-38228	K-38244	201 00	
200	35 ½	14 ½	4 ½	225	18	K-38229	K-38245	223 00	
200	38 ½	14 ½	4 ½	235	20	K-38230	K-38246	245 00	
200	41 ½	14 ½	4 ½	250	22	K-38231	K-38247	263 00	
200	44 ½	14 ½	4 ½	265	24	K-38232	K-38248	288 00	
200	47 ½	14 ½	4 ½	280	26	K-38233	K-38249	310 00	
200	50 ½	14 ½	4 ½	310	28	K-38234	K-38250	334 00	
200	53 ½	14 ½	4 ½	325	30	K-38235	K-38251	359 00	
200	56 ½	14 ½	4 ½	340	32	K-38236	K-38252	384 00	
<b>3-Wire Mains</b>									
<b>125 Volts</b>									
30	11 ½	14 ½	4 ½	125	4	K-38318	K-38334	86 00	
30	14 ½	14 ½	4 ½	140	6	K-38319	K-38335	102 00	
30	17 ½	14 ½	4 ½	155	8	K-38320	K-38336	124 00	
30	20 ½	14 ½	4 ½	170	10	K-38321	K-38337	142 00	
60	23 ½	14 ½	4 ½	185	12	K-38322	K-38338	162 00	
60	26 ½	14 ½	4 ½	200	14	K-38323	K-38339	183 00	
60	29 ½	14 ½	4 ½	210	16	K-38324	K-38340	201 00	
60	32 ½	14 ½	4 ½	225	18	K-38325	K-38341	223 00	
60	35 ½	14 ½	4 ½	235	20	K-38326	K-38342	245 00	
100	38 ½	14 ½	4 ½	250	22	K-38327	K-38343	263 00	
100	41 ½	14 ½	4 ½	265	24	K-38328	K-38344	288 00	
100	44 ½	14 ½	4 ½	280	26	K-38329	K-38345	310 00	
100	47 ½	14 ½	4 ½	310	28	K-38330	K-38346	334 00	
100	50 ½	14 ½	4 ½	325	30	K-38331	K-38347	359 00	
100	53 ½	14 ½	4 ½	340	32	K-38332	K-38348	384 00	

Data sheet, form 7586, will be of valuable assistance in ordering.

Order by Style Number

TYPE S DEAD-FRONT SAFETY PANEL BOARDS—Continued

**Mains**—With unfused safety brush switch.  
**Branches**—Two-wire with special 30-ampere snap switches arranged for plug fuses.

**CABINETS**

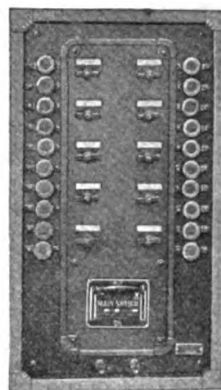
**Style FS**—Flush steel box and steel trim.  
**Style SS**—Surface steel box and steel trim.  
 For inside dimensions of box add 6½ inches to panel size for 3¼-inch gutter.  
 Through-feed panels and mains of larger capacity can be furnished at an additional cost.

Style number and list price do not include fuses.

Boxes will be drilled for conduit without extra charge provided complete drilling information accompanies order. Boxes will be shipped undrilled unless templates are sent with order showing location and sizes of holes wanted.

Knockouts for one half of the total number of circuits will be furnished without additional charge when requested on the initial order. Extra knockouts will be furnished at 10c each, list.

For panels with fuses in the mains add 4 per cent to list price of panel.  
 Panels with three-way switches can be furnished at an additional cost.



TYPE S PANEL BOARDS COMPLETE WITH CABINET

Amps. Capacity of Mains	Height	OUTSIDE DIMENSIONS OF PANELS IN INCHES		Approx. Shipping Wt., Lbs.	Number of Circuits	STYLE NUMBERS PLUG FUSES		List Price
		Width	Depth			Style FS	Style SS	
<b>2-Wire Mains</b>								
<b>125 Volts</b>								
30	19	14½	4½	150	4	K-38510	K-38526	\$133 00
60	22	14½	4½	170	6	K-38511	K-38527	153 00
60	25	14½	4½	190	8	K-38512	K-38528	175 00
60	28	14½	4½	205	10	K-38513	K-38529	197 00
100	31	14½	4½	225	12	K-38514	K-38530	217 00
100	34	14½	4½	240	14	K-38515	K-38531	239 00
100	37	14½	4½	250	16	K-38516	K-38532	259 00
200	40	14½	4½	270	18	K-38517	K-38533	281 00
200	43	14½	4½	280	20	K-38518	K-38534	303 00
200	46	14½	4½	300	22	K-38519	K-38535	330 00
200	49	14½	4½	320	24	K-38520	K-38536	346 00
200	52	14½	4½	340	26	K-38521	K-38537	361 00
200	55	14½	4½	375	28	K-38522	K-38538	388 00
200	58	14½	4½	390	30	K-38523	K-38539	410 00
200	61	14½	4½	410	32	K-38524	K-38540	429 00
<b>3-Wire Mains</b>								
<b>125 Volts</b>								
30	19	14½	4½	150	4	K-38606	K-38622	133 00
30	22	14½	4½	170	6	K-38607	K-38623	153 00
30	25	14½	4½	190	8	K-38608	K-38624	175 00
30	28	14½	4½	205	10	K-38609	K-38625	197 00
60	31	14½	4½	225	12	K-38610	K-38626	217 00
60	34	14½	4½	240	14	K-38611	K-38627	239 00
60	37	14½	4½	250	16	K-38612	K-38628	259 00
60	40	14½	4½	270	18	K-38613	K-38629	281 00
60	43	14½	4½	280	20	K-38614	K-38630	303 00
100	46	14½	4½	300	22	K-38615	K-38631	330 00
100	49	14½	4½	320	24	K-38616	K-38632	346 00
100	52	14½	4½	340	26	K-38617	K-38633	361 00
100	55	14½	4½	375	28	K-38618	K-38634	388 00
100	58	14½	4½	390	30	K-38619	K-38635	410 00
100	61	14½	4½	410	32	K-38620	K-38636	429 00

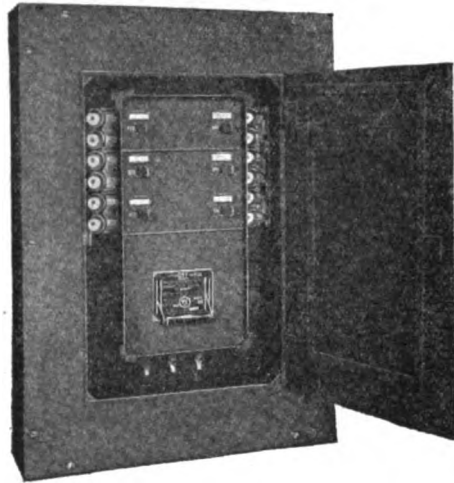
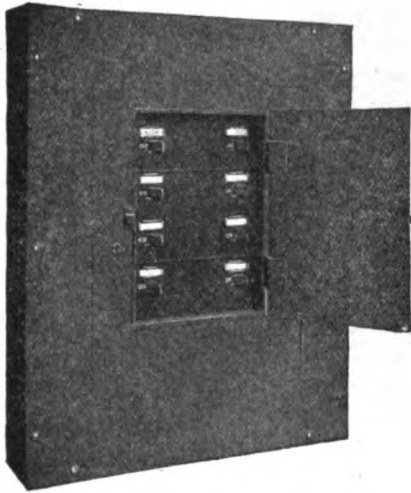
Data sheet, form 7586, will be of valuable assistance in ordering.

Order by Style Number



## TYPE T SAFETY PANEL BOARDS

### DEAD-FRONT THIRTY-AMPERE HEAVY-DUTY TUMBLER SWITCHES IN BRANCHES



#### Application

For control of lighting circuits in residences, apartment houses, hotels, stores, factories, schools, churches, etc., in fact, wherever a panel of these characteristics is required. The type T safety lighting panel board has been very carefully developed to meet these applications.

#### Distinctive Features

Type T safety panel boards are the result of the combined experience and efforts of the best engineers. No details have been omitted and no expense spared in the development of these panels to make them complete from an engineering standpoint. These panels have the approval of the National Board of Fire Underwriters.

Since a very large portion of panel boards sold are the result of architects' specifications, the type T panel board has been designed with the idea of combining good appearance with maximum quality and durability, resulting in a finished work which the best architects will readily appreciate.

To the contractor there is nothing which means more than service. All parts of type T panel boards are machine made in our Brooklyn Plant and shipped unassembled to local Westinghouse Service Shops where they may be quickly assembled to meet the varying specifications of architects and contractors. Every possible combination of panels can be quickly made into complete panels of the very highest quality in the minimum amount of time.

As a result of the combined efforts of engineers and tool designers, the details of the type T panel boards have been so carefully worked out that the minimum factory cost of the parts is secured and,

by assembly in the Service Shops, large stocks of completed panels are avoided. This assures to the user a maximum quality product at a minimum price.

#### General Specifications

**Mains**—Main terminal lugs are always placed at the bottom of the panels unless otherwise specified. If lugs are required at the top, instead of at the bottom of the panel, the size and the price will not be altered.

Capacities of mains as given in the lists are figured on a basis of 660 watts per branch circuit.

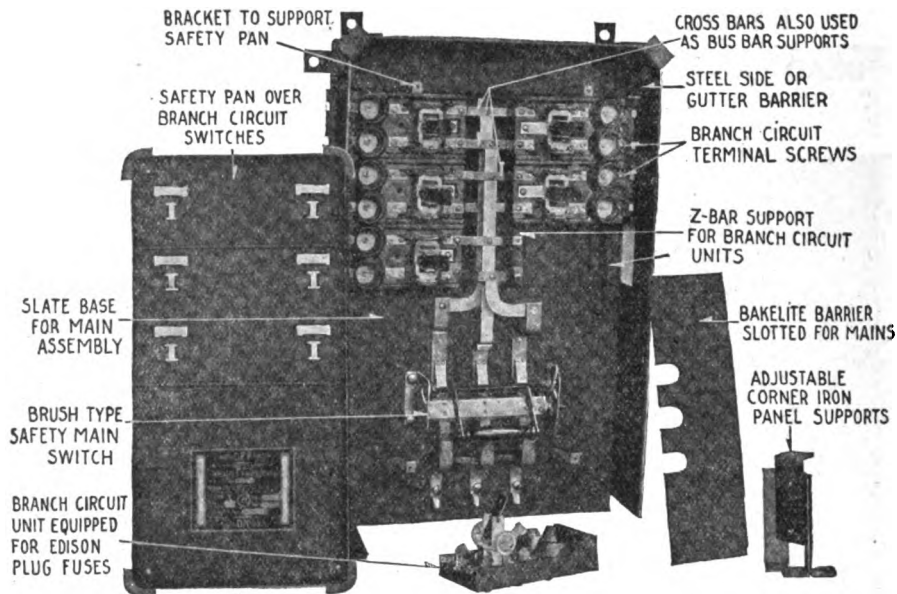
Through-feed panels and mains of larger capacity can be furnished at small additional cost.

**Three-Phase Connections**—If a 3/2 wire panel board is to be connected for a 125 or 250-volt three-phase system, the order must so indicate and the panel board will be furnished accordingly. This change in connections neither alters the size nor the price of the panel board.

**Branch Circuits**—All type T panel boards are equipped with standard tumbler-type switch units with 250-volt spacing and liberally designed to carry 30 amperes. Each switch with necessary contacts is rigidly mounted on an individual composition base on which are also mounted N. E. C. fuse clips or Edison Plug Fuse receptacles as required. All necessary lining up and adjustments of contacts are made on these units before assembly into panel boards. Switches are both quick-make and quick-break and are also double-break, dividing the arc between two points. The carrying capacity is sufficient to handle 30 amperes continuously.

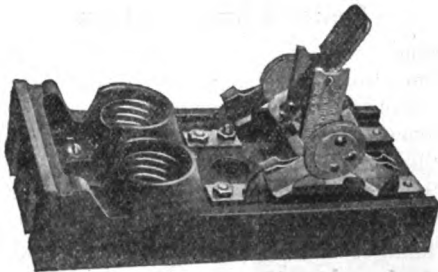
Three and four-pole branch circuit units are being developed. Prices will be furnished on request.

## TYPE T SAFETY PANEL BOARDS—Continued



Branch switches are placed between bus-bars and fuse receptacles, rendering fuses and switch blades dead when switch is open.

All circuit switches, fuse clips, fuse receptacles, branch and main bus-bars are removable from the front, making it possible to replace any of these parts



without disconnecting or removing or in any way disturbing the panel board or removing the trim.

**Cabinets and Trims**—Steel cabinets and trims are of thickness specified by National Electrical Code.

The trims or fronts are of the "door within a door" construction. The inner door allows access only to the operating handles of the branch and main switches. The outer door, which allows access to the branch and main circuit fuses, is provided with a Yale lock and can be opened only by authorized persons.

Boxes will be drilled for conduit without extra charge, if complete drilling information accompanies order. Boxes will be shipped undrilled unless templates are sent with order showing location and sizes of holes wanted.

Knockouts for one-half the total number of circuits will be furnished without additional charge when requested on the initial order. Extra knockouts will be furnished at 10 cents each list.

Current density of conducting parts is 1,000 amperes per square inch of cross section.

All current-carrying parts are spaced in accordance with the latest requirements of the National Board of Fire Underwriters for 250-volt service.

Conducting parts of all panels are made of pure drawn copper.

Standard finish of current-carrying parts, plain dipped finish.

Bus-bars are superimposed, reducing the width of the panel to a minimum and allowing for three-phase to single-phase distribution.

**Fusible Mains**—Mains may be arranged for N. E. C. fuses. This increases the size of the panel and also increases the price. If FUSIBLE MAINS ONLY are required add 8 per cent to list price of corresponding panel with lugs only in the mains. If FUSIBLE MAIN SWITCH is required add 4 per cent to list price of corresponding panel with unfusible main switch.

**Main Switches**—Main switches, when used, are of the standard brush type construction with galvanized steel toggle mechanism. They are quick-break and double-break and are provided with arcing tips at each end. They are of ample capacity to stand 50 per cent more than their rated capacity. These switches are removable as a unit and are interchangeable. Main switches may be placed under a separate door on special orders.

**Circuit Connections**—All 2/2 wire panel boards are connected in the regular manner, each pole being fed by a separate bar. All 3/2 wire panel boards are connected for the Edison 3-wire system; that is, each branch circuit has one pole connected to the neutral bus-bar and the other pole connected to one of the two outside bus-bars.

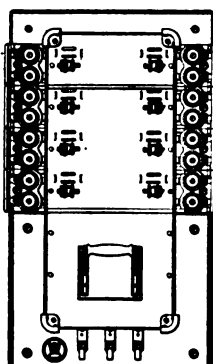
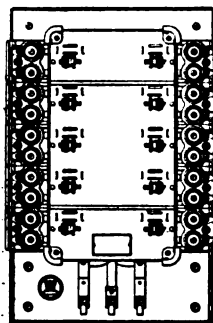
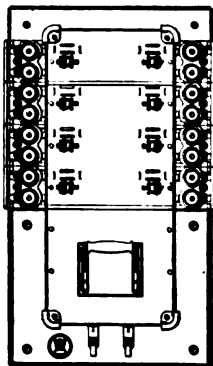
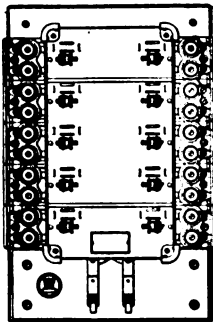
All 3/2 wire panel boards are connected so that each pole is fed by a separate bar.

TYPE T SAFETY PANEL BOARDS—Continued

TYPE T DEAD-FRONT PANEL BOARDS AND CABINETS

With two-pole 30-ampere Edison plug fusible tumbler-type switches in the branch circuits

Style number and list price include panel board complete in standard-code-thickness sheet steel cabinet with steel trim, black marine finish. Prices do not include any fuses.



Amps. Cap. of Mains	INSIDE DIMENSIONS OF CABINET, INCHES			No. of Cir.	Approx. Shipping Wt., Lbs.	STYLE NUMBERS	Surface Cabinet	List Price
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TWO-WIRE BRANCH CIRCUITS

2-Wire Mains: 125 Volts, Lugs Only

30	22 1/2	22 1/2	5 1/2	4	110	K-56892	K-56892	\$ 69 00
60	25 1/2	22 1/2	5 1/2	6	120	K-56893	K-56893	79 00
60	28 1/2	22 1/2	5 1/2	8	130	K-56894	K-56894	90 00
60	31 1/2	22 1/2	5 1/2	10	140	K-56895	K-56895	101 00
100	34 1/2	22 1/2	5 1/2	12	150	K-56896	K-56896	112 00
100	37 1/2	22 1/2	5 1/2	14	160	K-56897	K-56897	124 00
100	40 1/2	22 1/2	5 1/2	16	175	K-56898	K-56898	136 00
200	43 1/2	22 1/2	5 1/2	18	185	K-56899	K-56899	148 00
200	46 1/2	22 1/2	5 1/2	20	195	K-56700	K-56900	162 00
200	49 1/2	22 1/2	5 1/2	22	205	K-56701	K-56901	174 00
200	52 1/2	22 1/2	5 1/2	24	215	K-56702	K-56902	185 00
200	55 1/2	22 1/2	5 1/2	26	225	K-56703	K-56903	199 00
200	58 1/2	22 1/2	5 1/2	28	235	K-56704	K-56904	212 00
200	61 1/2	22 1/2	5 1/2	30	250	K-56705	K-56905	226 00
200	64 1/2	22 1/2	5 1/2	32	260	K-56706	K-56906	238 00

2-Wire Mains: 125 Volts, Unfusible Switch

30	28 1/2	22 1/2	5 1/2	4	135	K-56722	K-56922	90 00
60	31 1/2	22 1/2	5 1/2	6	150	K-56723	K-56923	101 00
60	34 1/2	22 1/2	5 1/2	8	160	K-56724	K-56924	111 00
60	37 1/2	22 1/2	5 1/2	10	170	K-56725	K-56925	122 00
100	40 1/2	22 1/2	5 1/2	12	185	K-56726	K-56926	135 00
100	43 1/2	22 1/2	5 1/2	14	195	K-56727	K-56927	147 00
100	46 1/2	22 1/2	5 1/2	16	205	K-56728	K-56928	159 00
200	49 1/2	22 1/2	5 1/2	18	220	K-56729	K-56929	172 00
200	52 1/2	22 1/2	5 1/2	20	230	K-56730	K-56930	189 00
200	55 1/2	22 1/2	5 1/2	22	240	K-56731	K-56931	202 00
200	58 1/2	22 1/2	5 1/2	24	250	K-56732	K-56932	215 00
200	61 1/2	22 1/2	5 1/2	26	260	K-56733	K-56933	228 00
200	64 1/2	22 1/2	5 1/2	28	275	K-56734	K-56934	242 00
200	67 1/2	22 1/2	5 1/2	30	285	K-56735	K-56935	256 00
200	70 1/2	22 1/2	5 1/2	32	300	K-56736	K-56936	268 00

3-Wire Mains: 125 Volts, Lugs Only

30	22 1/2	22 1/2	5 1/2	4	110	K-56832	K-56832	69 00
30	25 1/2	22 1/2	5 1/2	6	120	K-56833	K-56833	79 00
30	28 1/2	22 1/2	5 1/2	8	130	K-56834	K-56834	90 00
30	31 1/2	22 1/2	5 1/2	10	140	K-56835	K-56835	101 00
60	34 1/2	22 1/2	5 1/2	12	150	K-56836	K-56836	112 00
60	37 1/2	22 1/2	5 1/2	14	160	K-56837	K-56837	124 00
60	40 1/2	22 1/2	5 1/2	16	175	K-56838	K-56838	135 00
60	43 1/2	22 1/2	5 1/2	18	185	K-56839	K-56839	148 00
60	46 1/2	22 1/2	5 1/2	20	195	K-56840	K-56840	162 00
100	49 1/2	22 1/2	5 1/2	22	205	K-56841	K-56841	174 00
100	52 1/2	22 1/2	5 1/2	24	215	K-56842	K-56842	185 00
100	55 1/2	22 1/2	5 1/2	26	225	K-56843	K-56843	199 00
100	58 1/2	22 1/2	5 1/2	28	235	K-56844	K-56844	212 00
100	61 1/2	22 1/2	5 1/2	30	250	K-56845	K-56845	226 00
100	64 1/2	22 1/2	5 1/2	32	260	K-56846	K-56846	238 00

3-Wire Mains: 125 Volts, Unfusible Switch

30	28 1/2	22 1/2	5 1/2	4	135	K-56862	K-56862	90 00
30	31 1/2	22 1/2	5 1/2	6	150	K-56863	K-56863	101 00
30	34 1/2	22 1/2	5 1/2	8	160	K-56864	K-56864	111 00
30	37 1/2	22 1/2	5 1/2	10	170	K-56865	K-56865	122 00
60	40 1/2	22 1/2	5 1/2	12	185	K-56866	K-56866	135 00
60	43 1/2	22 1/2	5 1/2	14	195	K-56867	K-56867	147 00
60	46 1/2	22 1/2	5 1/2	16	205	K-56868	K-56868	159 00
60	49 1/2	22 1/2	5 1/2	18	220	K-56869	K-56869	172 00
60	52 1/2	22 1/2	5 1/2	20	230	K-56870	K-56870	189 00
100	55 1/2	22 1/2	5 1/2	22	240	K-56871	K-56871	202 00
100	58 1/2	22 1/2	5 1/2	24	250	K-56872	K-56872	215 00
100	61 1/2	22 1/2	5 1/2	26	260	K-56873	K-56873	228 00
100	64 1/2	22 1/2	5 1/2	28	275	K-56874	K-56874	242 00
100	67 1/2	22 1/2	5 1/2	30	285	K-56875	K-56875	256 00
100	70 1/2	22 1/2	5 1/2	32	300	K-56876	K-56876	268 00

For panels with more than 32 circuits add \$20.00 list for each additional pair of circuits to above prices of 32-Circuit Panels.

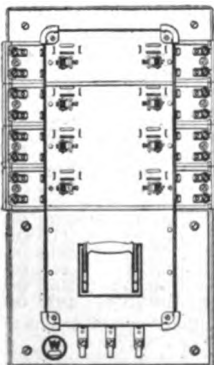
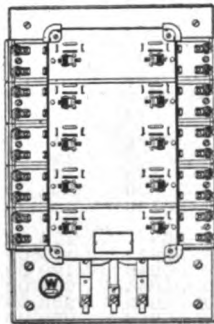
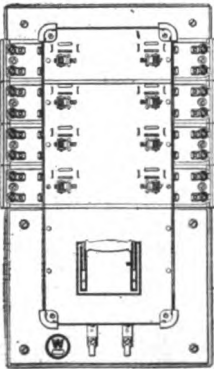
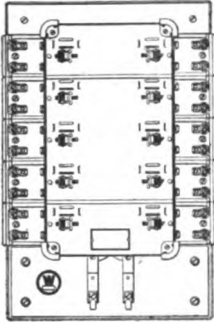
Order by Style Number

TYPE T SAFETY PANEL BOARDS—Continued

TYPE T DEAD-FRONT PANEL BOARDS AND CABINETS

With two-pole 30-ampere N. E. C. fusible  
tumbler-type switches in the branch circuits

Style number and list price include panel board complete in standard-code-thickness sheet steel cabinet with steel trim, black marine finish. Prices do not include any fuses.



TWO-WIRE BRANCH CIRCUITS

Amps. Cap. of Mains	INSIDE DIMENSIONS OF CABINET, INCHES			No. of Cir.	Approx. Shipping Wt., Lbs.	STYLE NUMBERS		List Price
	Height	Width	Depth			Flush Cabinet	Surface Cabinet	
<b>2-Wire Mains: 125 and 250 Volts, Lugs Only</b>								
30	22 1/2	22 1/2	5 1/2	4	110	K-56877	K-56877	\$ 69 00
60	25 1/2	22 1/2	5 1/2	6	120	K-56878	K-56878	79 00
60	28 1/2	22 1/2	5 1/2	8	130	K-56879	K-56879	90 00
60	31 1/2	22 1/2	5 1/2	10	140	K-56880	K-56880	101 00
100	34 1/2	22 1/2	5 1/2	12	150	K-56881	K-56881	112 00
100	37 1/2	22 1/2	5 1/2	14	160	K-56882	K-56882	124 00
100	40 1/2	22 1/2	5 1/2	16	175	K-56883	K-56883	135 00
200	43 1/2	22 1/2	5 1/2	18	185	K-56884	K-56884	148 00
200	46 1/2	22 1/2	5 1/2	20	195	K-56885	K-56885	162 00
200	49 1/2	22 1/2	5 1/2	22	205	K-56886	K-56886	174 00
200	52 1/2	22 1/2	5 1/2	24	215	K-56887	K-56887	185 00
200	55 1/2	22 1/2	5 1/2	26	225	K-56888	K-56888	199 00
200	58 1/2	22 1/2	5 1/2	28	235	K-56889	K-56889	212 00
200	61 1/2	22 1/2	5 1/2	30	250	K-56890	K-56890	226 00
200	64 1/2	22 1/2	5 1/2	32	260	K-56891	K-56891	238 00

2-Wire Mains: 125 and 250 Volts, Unfusible Switch

30	28 1/2	22 1/2	5 1/2	4	135	K-56707	K-56907	90 00
60	31 1/2	22 1/2	5 1/2	6	150	K-56708	K-56908	101 00
60	34 1/2	22 1/2	5 1/2	8	160	K-56709	K-56909	111 00
60	37 1/2	22 1/2	5 1/2	10	170	K-56710	K-56910	122 00
100	40 1/2	22 1/2	5 1/2	12	185	K-56711	K-56911	135 00
100	43 1/2	22 1/2	5 1/2	14	195	K-56712	K-56912	147 00
100	46 1/2	22 1/2	5 1/2	16	205	K-56713	K-56913	159 00
200	49 1/2	22 1/2	5 1/2	18	220	K-56714	K-56914	172 00
200	52 1/2	22 1/2	5 1/2	20	230	K-56715	K-56915	189 00
200	55 1/2	22 1/2	5 1/2	22	240	K-56716	K-56916	202 00
200	58 1/2	22 1/2	5 1/2	24	250	K-56717	K-56917	215 00
200	61 1/2	22 1/2	5 1/2	26	260	K-56718	K-56918	228 00
200	64 1/2	22 1/2	5 1/2	28	275	K-56719	K-56919	242 00
200	67 1/2	22 1/2	5 1/2	30	285	K-56720	K-56920	256 00
200	70 1/2	22 1/2	5 1/2	32	300	K-56721	K-56921	268 00

3-Wire Mains: 125 Volts, Lugs Only

30	22 1/2	22 1/2	5 1/2	4	110	K-56817	K-56817	69 00
30	25 1/2	22 1/2	5 1/2	6	120	K-56818	K-56818	79 00
30	28 1/2	22 1/2	5 1/2	8	130	K-56819	K-56819	90 00
30	31 1/2	22 1/2	5 1/2	10	140	K-56820	K-56820	101 00
60	34 1/2	22 1/2	5 1/2	12	150	K-56821	K-56821	112 00
60	37 1/2	22 1/2	5 1/2	14	160	K-56822	K-56822	124 00
60	40 1/2	22 1/2	5 1/2	16	175	K-56823	K-56823	135 00
60	43 1/2	22 1/2	5 1/2	18	185	K-56824	K-56824	148 00
60	46 1/2	22 1/2	5 1/2	20	195	K-56825	K-56825	162 00
100	49 1/2	22 1/2	5 1/2	22	205	K-56826	K-56826	174 00
100	52 1/2	22 1/2	5 1/2	24	215	K-56827	K-56827	185 00
100	55 1/2	22 1/2	5 1/2	26	225	K-56828	K-56828	199 00
100	58 1/2	22 1/2	5 1/2	28	235	K-56829	K-56829	212 00
100	61 1/2	22 1/2	5 1/2	30	250	K-56830	K-56830	226 00
100	64 1/2	22 1/2	5 1/2	32	260	K-56831	K-56831	238 00

3-Wire Mains: 125 Volts, Unfusible Switch

30	28 1/2	22 1/2	5 1/2	4	135	K-56847	K-56847	90 00
30	31 1/2	22 1/2	5 1/2	6	150	K-56848	K-56848	101 00
30	34 1/2	22 1/2	5 1/2	8	160	K-56849	K-56849	111 00
30	37 1/2	22 1/2	5 1/2	10	170	K-56850	K-56850	122 00
60	40 1/2	22 1/2	5 1/2	12	185	K-56851	K-56851	135 00
60	43 1/2	22 1/2	5 1/2	14	195	K-56852	K-56852	147 00
60	46 1/2	22 1/2	5 1/2	16	205	K-56853	K-56853	159 00
60	49 1/2	22 1/2	5 1/2	18	220	K-56854	K-56854	172 00
60	52 1/2	22 1/2	5 1/2	20	230	K-56855	K-56855	189 00
100	55 1/2	22 1/2	5 1/2	22	240	K-56856	K-56856	202 00
100	58 1/2	22 1/2	5 1/2	24	250	K-56857	K-56857	215 00
100	61 1/2	22 1/2	5 1/2	26	260	K-56858	K-56858	228 00
100	64 1/2	22 1/2	5 1/2	28	275	K-56859	K-56859	242 00
100	67 1/2	22 1/2	5 1/2	30	285	K-56860	K-56860	256 00
100	70 1/2	22 1/2	5 1/2	32	300	K-56861	K-56861	268 00

For panels with more than 32 circuits add \$20.00 list for each additional pair of circuits to above prices of 32-Circuit Panels.

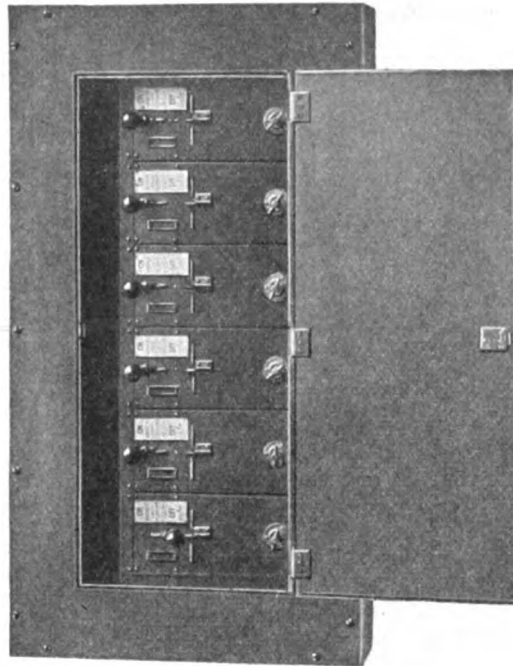
Order by Style Number

12-153A

## SAFETY AUTO-LOCK CONTROL PANELS

### DEAD-FRONT FOR LIGHT AND POWER DISTRIBUTION

125-250 Volts D-C. and 600 Volts A-C.



SAFETY AUTO-LOCK CONTROL  
PANEL WITH CABINET DOOR OPEN

Safety auto-lock panels are used in light or power distribution for 125-250-volt direct-current or 600-volt alternating-current service. They are made up of switches of the standard autolock type, all the safety features being maintained.

#### Construction

These panels are mounted on a common base of slate and all switches make direct contact to a common set of bus-bars. Each switch is separated from its neighbor by means of a slate barrier and since each switch is provided with an individual cover it is possible to work with perfect safety on any one switch without throwing off current of neighboring switches. The panels may be made up single-branch; with all circuits on one side of the main bus-bar, or double-branch with switches

mounted on both sides of main bus. A main switch may also be provided either fused or unfused.

Each switch has a provision for a padlock to lock it in the open position, and all parts are removable from the front without disturbing wire connections or removing the panel from wall. Repairs may therefore be made with least possible delay and expense.

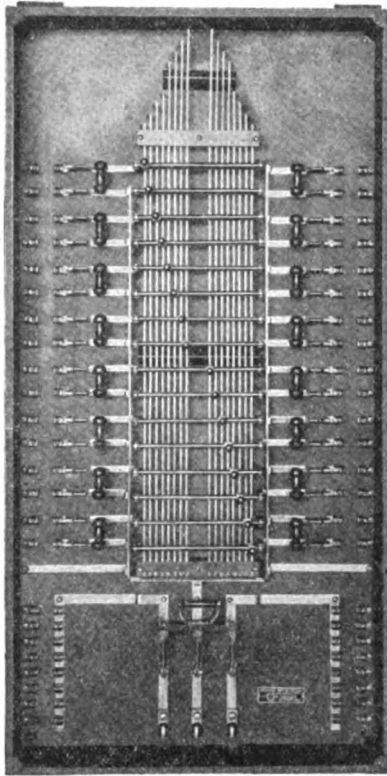
The panel is enclosed in an iron cabinet with a door which opens over the switches, but at no time are the bus or cross-bars exposed. The entire outfit is compact, neat in appearance and practically dust-proof.

Any number of circuits can be furnished ranging from 30 to 600 amperes for 125-250 volts, direct current, or 600 volts, alternating current.

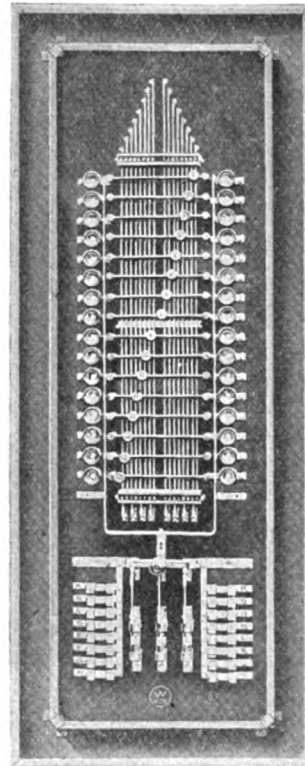
*Prices on Application*

## McWILLIAMS SIMPLICITY METERING PANEL BOARDS

(Manufactured under the McWilliams and Other Patents)



PANEL WITH SLATE FRAME



PANEL IN IRON BOX WITH WIRING GUTTER

### Application

McWilliams simplicity metering panel boards are particularly applicable to office buildings, apartment buildings, warehouses, factories, lofts, stores, etc. They are used wherever it is desirable to connect a circuit, or combination of circuits, through any one of a number of meters by simply changing the location of the metering connectors on the face of the board.

When this panel board is used in an office building, it is only necessary to supply a meter for each tenant. Formerly a meter was required for each room. Any room or combination of rooms can be metered through one meter by changing the location of the meter connector on the face of the board. Changes in or additions to tenants' space can be

provided for quickly at no expense. The meter equipment and cost of meter readings are greatly reduced. Mistakes and fire risks are eliminated.

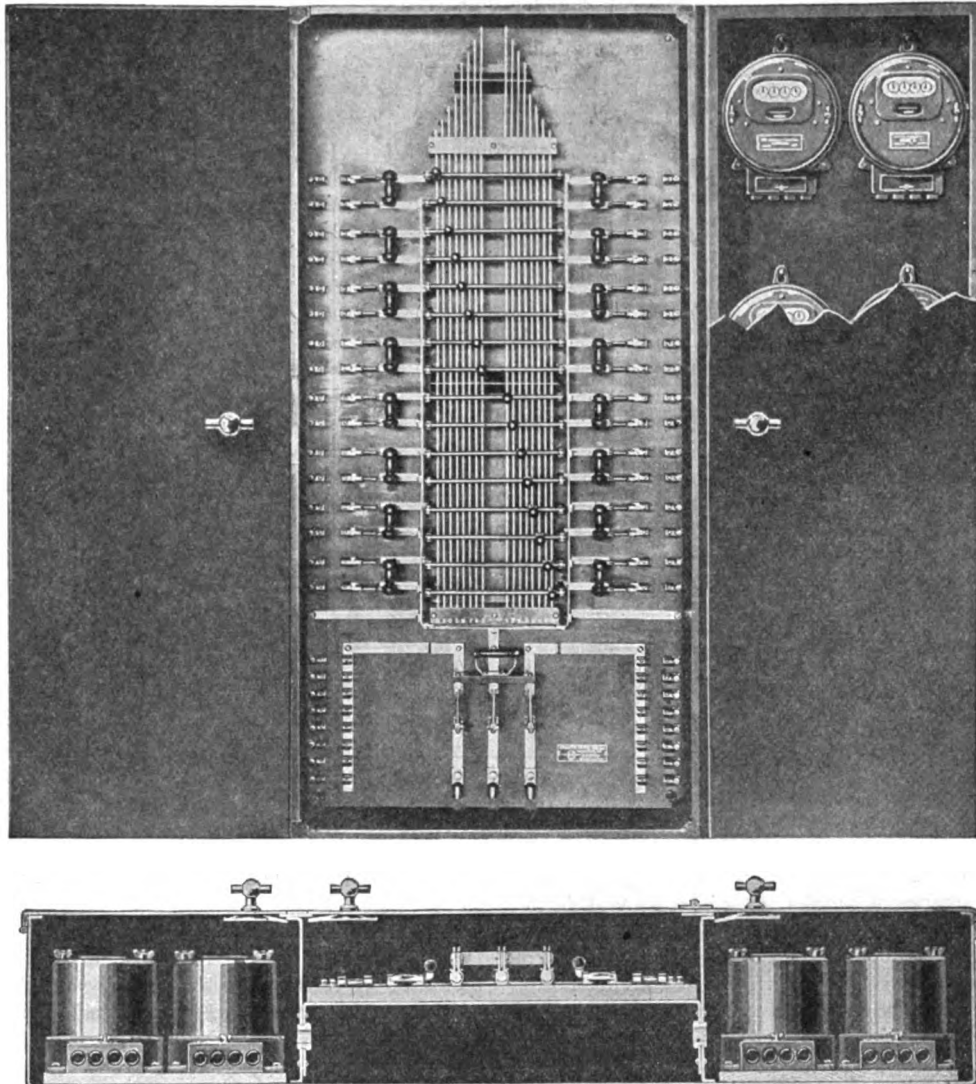
Modern apartment buildings furnish laundry, vacuum cleaning, storage rooms and servants' quarters for tenants' use. With this panel board the current used for operating these devices can be metered through any tenant's meter as desired.

In warehouses, factories, lofts, etc., tenants' current can be metered to care for changes or additions to space without changing the wiring in the building.

In factories, apartments and stores it is often necessary to charge the current used to departments or work in progress. The metering panel board offers an easy, accurate and safe means for doing this.

McWILLIAMS SIMPLICITY METERING PANEL BOARDS—Continued

**McWILLIAMS METERING PANEL BOARDS ENCLOSED  
IN TYPICAL METER CLOSETS**



**PRICES**

Prices on metering panel boards, enclosed in meter closets, will be quoted on request. In asking for quotation on such boards, specify the number and make of the meters to be enclosed.

McWILLIAMS SIMPLICITY METERING PANEL BOARDS—Continued

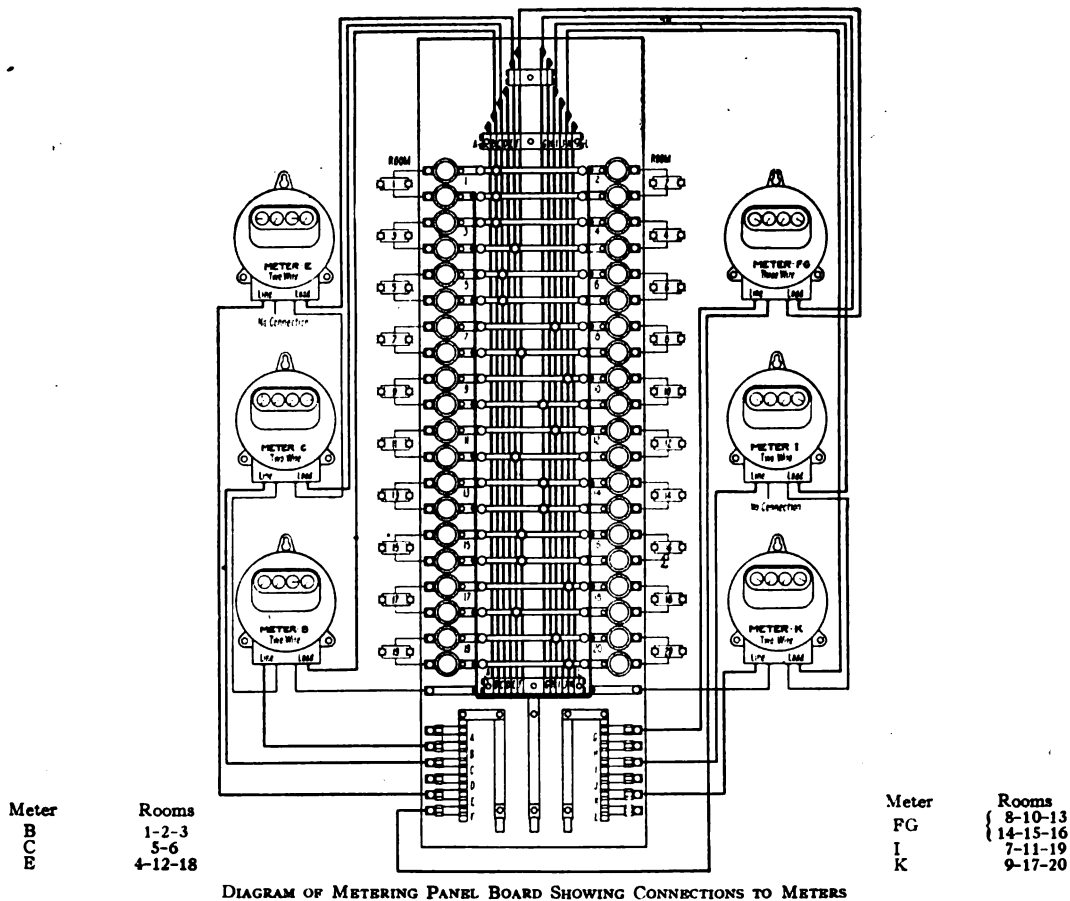


DIAGRAM OF METERING PANEL BOARD SHOWING CONNECTIONS TO METERS

**Distinctive Features**

McWilliams simplicity metering panel boards have a series of parallel meter bars lying all in the same plane, extending lengthwise on the panel board. Crossing these meter bars and supported above them are round consumption circuit bars. The ends of these consumption bars are connected through fuses to the circuits to be metered. On these bars are placed sliding and rotating switch contactors. The operator can easily move the contactor from one meter

bar to another and clamp the contactor in the selected location. The meter fuses are arranged so that they can be easily placed in multiple, to the end that additional fuse capacity can be obtained for any desired meter. All bus-bars and wire terminals are arranged to show clearly every connection; in fact, the panel board itself might be considered a full scale wiring diagram. This feature prevents improper meter and wire connections.

**PRICES**

Prices on metering panels will be furnished on request. To eliminate errors and delays, give full details of specifications, if possible.



## SAFETY CAR PANELS (DEAD FRONT)

For Use on 600-Volt Circuits



SAFETY CAR PANEL WITH CABINET COVERS CLOSED

### Application

Safety car panels are designed for the control of 600-volt lighting, heating, and small motor circuits in electric railway cars. They will carry circuits up to 30 amperes, supplied from railway feeders.

Safety to the operator is not only desirable but essential in the operation of such circuits at railway line voltages owing to the fact that the operation of these circuits is frequently by individuals not connected with car operation and not familiar with the very real life hazards from contact with 600-volt live circuits.

These car panels are being used by some of the largest subway and elevated railways in the country.

### Distinctive Features

Safety car panels provide complete safety, as all live parts are fully inclosed in the ordinary operation of the switches.

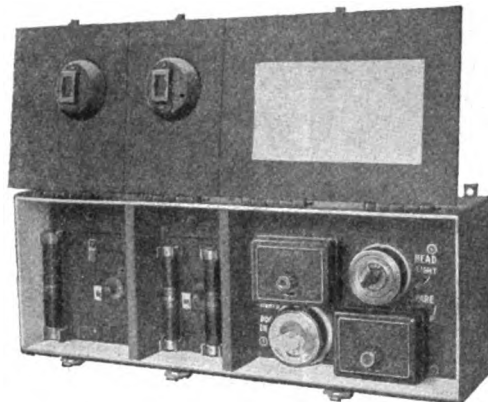
The cabinet covers over the compressor and heating switches are interlocked with the handles so that the switch must be "off" before the cover can be opened. This renders the fuses "dead" when the cover is opened.

The handles of the compressor and heating switches are recessed in the cover of the cabinet.

### Operating Characteristics and Construction

These safety car panels are mounted in a strong steel cabinet with steel doors held closed by snap catches. The cabinet is lined with asbestos board.

The heating and compressor motor switches are of special design, using arc quenching barriers. The handles of these switches extend through the cabinet cover which is recessed to keep the handles flush with the cabinet.



COVERS OPEN SHOWING OPERATING PARTS

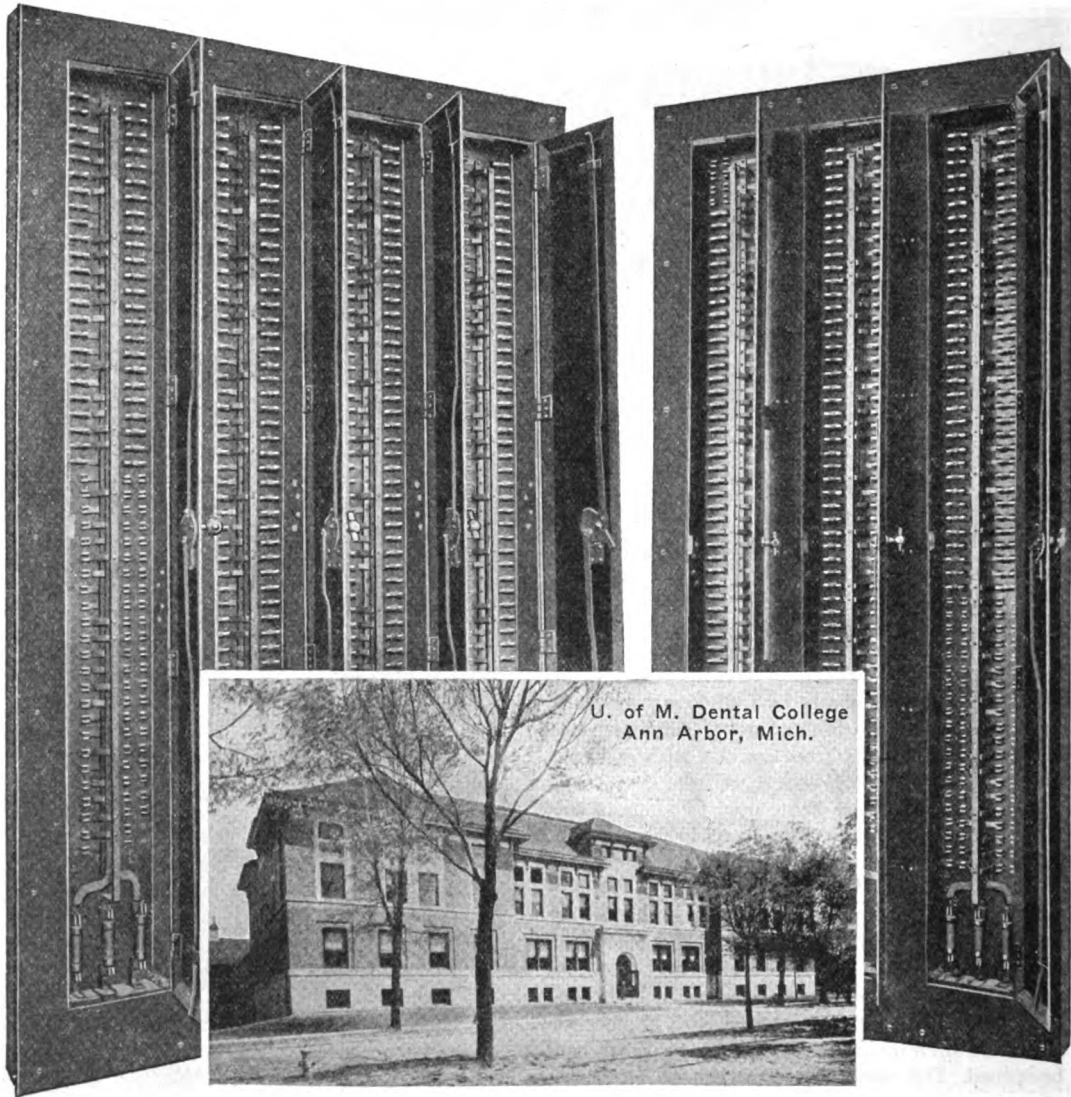
The small lighting switches are grouped in a separate compartment. These switches are of the standard railway lighting snap switch type.

All switches are of the snap action type.

On account of shortage of available space for mounting these panels, the outside dimensions are reduced to a minimum, yet ample space for proper operation is maintained.

*Prices on Application*

## WESTINGHOUSE PANEL BOARDS CAN BE FURNISHED TO MEET ANY REQUIREMENTS



190- AND 160-CIRCUIT WESTINGHOUSE PANEL BOARDS INSTALLED IN THE DENTAL BUILDING,  
UNIVERSITY OF MICHIGAN, ANN ARBOR, MICHIGAN

Valuable information and advice on safety panel board requirements can be furnished by our Panel Board Engineers. Such help is gladly given without obligation. Consult nearest Westinghouse agent-jobber or Westinghouse district office.

## WESTINGHOUSE COOPER-HEWITT MERCURY RECTIFIER OUTFITS APPLICATION

These outfits are used for the purpose of changing alternating current to direct current. They cannot be used to change direct current to alternating current, and are intended for use only where alternating current is available, to obtain direct current necessary for the following purposes:

Battery charging for automobiles;  
 Battery charging for igniters for internal combustion engines;  
 Battery charging for telephone service;

Battery charging for signal and alarm systems;  
 Battery charging for railroad car lighting;  
 Battery charging for chemical work;  
 Battery charging for telegraph;  
 Battery charging for motor boats;  
 Arc lamps for projection purposes;  
 Arc lamps for moving picture machines;  
 Electrolytic work and electroplating;  
 Motors with battery for small medical and dental outfits; for graphophones, etc.

### ADVANTAGES OF THE RECTIFIER

The mercury rectifier is a true rectifier. It acts as a switch, opening and closing alternate paths in such a manner that the two halves of the alternating-current waves are transformed into uni-directional waves, without other loss than the low electromotive force required to overcome the resistance of the bulb.

These rectifiers are easy to install and require

little space, and their first cost is low compared with other devices used for changing alternating current to direct current. They are very simple to operate, and have no moving parts. The regulation of current is effected by means of an auto-transformer, so that power is not wasted; the efficiency of operation is therefore high.

### PRINCIPLE OF OPERATION

The mercury rectifier consists essentially of a hermetically sealed glass bulb filled with mercury vapor and provided with four electrodes. The two upper electrodes (Fig. 1) are of graphite or other suitable material and the two lower of mercury. The graphite electrodes are the **anodes**; the main mercury electrode is the **cathode**; and the small one is the **supplementary starting** electrode. The mercury pools of the two lower electrodes are not in contact when the bulb is vertical, but the bulb is so mounted that it can be tilted to bring these two pools temporarily in contact for starting.

The bulb contains highly attenuated vapor of mercury, which, like other metal vapors, is an electrical conductor under some conditions. The anodes are surrounded by this vapor. Current can readily pass from either of the solid electrodes to the mercury vapor and from it to the mercury electrode, but when the direction of flow tends to reverse so that current would pass from the vapor to the solid electrode, there is a resistance at the surface of the electrode, which entirely prevents the flow of current. The alternating-current supply circuit is connected to the two anodes as shown in the diagram (Fig. 1), and as the anodes will allow current to flow in only one direction and oppose any current flow in the opposite direction, the pulsations of the current pass alternately from one or the other of the anodes into the mercury. As these currents cannot pass from the vapor into either anode, they are constrained to pass out all in one direction through the mercury electrode, from which they emerge as a

uni-directional current. The anodes of the rectifier thus act as check valves, permitting current to pass into the mercury vapor, but preventing it from passing from the vapor to the solid electrodes.

Before the bulb starts to rectify, there is a high resistance at the surface of the mercury, which must be broken down so that the current can pass. This surface resistance is called the **cathode resistance**, and it acts like an insulating film over the entire surface of the mercury. The film must be punctured, or, in other words, the resistance must be overcome before any current can pass. When once started, the current will continue to flow, meeting with practically no resistance as long as the current is uninterrupted. Any interruption of the current, however, even for the smallest instant of time, permits the cathode resistance to re-establish itself, which stops the operation of the bulb.

In order to overcome this resistance the bulb is tilted or shaken so that the space between the main and supplementary mercury electrodes is bridged by the mercury. Current then passes between the two mercury electrodes from the source of e. m. f., and the little stream of mercury which bridges the space between the electrodes breaks with a spark as the bulb is returned to vertical position. This

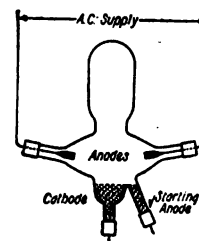


FIG. 1-DIAGRAM OF COOPER  
HEWITT MERCURY  
RECTIFIER BULB

## WESTINGHOUSE COOPER-HEWITT MERCURY RECTIFIER OUTFITS—Continued

spark breaks down the cathode resistance, after which the rectifier will continue to operate indefinitely as long as the current supply is uninterrupted and the direct-current load does not fall below the minimum required for the arc.

The action of the rectifier will be better understood by reference to the accompanying diagram, (Fig. 2), of current waves and impressed electromotive force. It should be emphasized that the whole of the alternating-current wave on both sides of the zero line is used. The two upper curves in the diagram show the current waves in each of the two anodes and the resultant curve III represents the rectified current flowing from the cathode. Curve IV shows the impressed alternating-current e. m. f. It is evident that if the part of the wave below the zero line was reversed the resulting current would be a pulsating direct current with each pulsation varying from zero to a positive maximum. Such a current could not be maintained by the rectifier, for as soon as the zero value was reached the cathode resistance of the rectifier would be re-established and the circuit would be broken. To avoid this condition, reactance is introduced into the direct-current circuit, which causes an elongation of current waves so that they overlap before reaching the zero value. The overlapping of the rectified current waves reduces the amplitude of the pulsations and produces a comparatively smooth direct current as shown in curve III.

The complete circuit of a mercury rectifier such as the type AN, is shown in the accompanying schematic diagram (Fig. 3) of connections for battery charging. The alternating-current supply circuit of either 110 or 220 volts is connected to suitable taps of an auto-transformer whose terminals are connected to the two anodes of the rectifier bulb.

From the cathode C the current passes through the battery to be charged and the circuit is completed through a connection to the middle point of the auto-transformer. The auxiliary starting electrode S is so connected as to make it possible to produce a local current between S and C. When the bulb is tilted a mercury contact is formed between the electrodes C and S and a current is established, and when the bulb is returned to the vertical position a spark breaks down the cathode resistance and the bulb starts into operation.

The reactance coil in the primary circuit is used to give the outfit the characteristics which are suitable to battery charging, i. e., poor regulation. Without this coil the direct-current voltage of the load would be constant and as the battery voltage changed during charge the current would vary through a wide range. With the poor regulation characteristics, secured by the addition of this coil, an increase in battery voltage is compensated for by a change in output voltage of the rectifier without very great changes in current. The same characteristics are secured in some cases by the use of two coils in the leads from the anode to the ends of the transformer secondary. In some outfits where two winding transformers are used instead of auto-transformers and even in some auto-transformers where the ratio is large, the desired regulation is secured by leakage reactance between the primary and secondary windings.

Fig. 4 shows how the same result is attained and at the same time the bulb tilted by means of a magnet. When the two portions of the mercury come together they short-circuit the tilting coil and so reduce its pull to zero. The bulb promptly swings back and breaks the mercury bridge, producing the required spark.

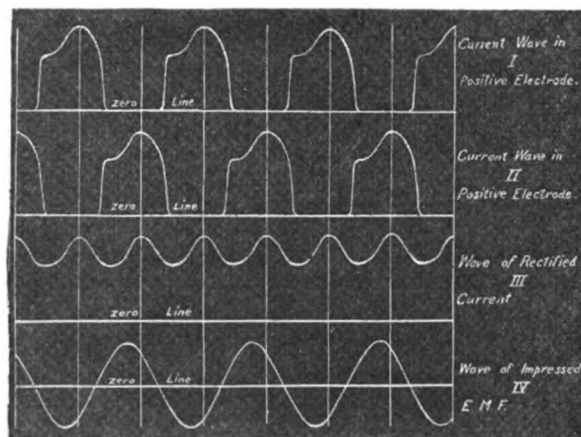


FIG. 2—DIAGRAM SHOWING CURRENT WAVES AND IMPRESSED ELECTROMOTIVE FORCE

WESTINGHOUSE COOPER-HEWITT MERCURY RECTIFIER OUTFITS—Continued

**Bulbs**—The bulbs used in Westinghouse mercury rectifiers are of glass. The terminals are sealed in and the bulb is charged with mercury, exhausted and sealed. In operation a certain amount of heat is developed and a portion of the mercury is evaporated. This increases the vapor pressure inside of the bulb. The bulb is made with a sufficient amount of surface to act as a condenser for the mercury vapor, and this condensation serves to maintain a low operating temperature. The bulb is

the only part of the rectifier outfit that requires renewal.

The bulb is mounted in a cradle which is connected to a handle or an automatic tilting device. The bulbs are rated by their direct-current voltages and current rating, and can be used on any commercial frequency. The maximum rating of the bulb should not be exceeded. The terminals of the electrodes, outside of the bulbs, are provided with metal caps to which the connections are made.

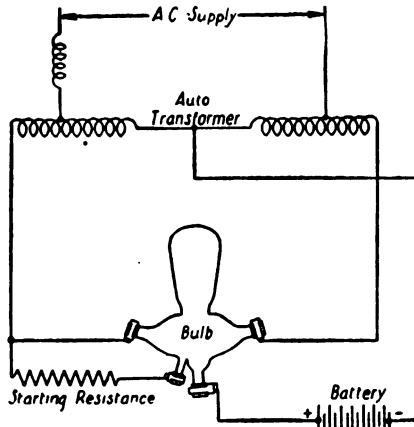


FIG. 3—DIAGRAM OF CONNECTIONS FOR BATTERY CHARGING

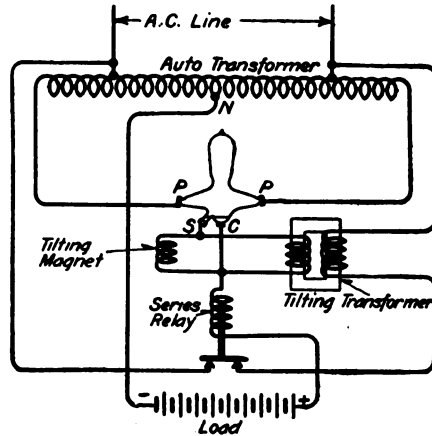


FIG. 4—TYPICAL DIAGRAM OF CONNECTIONS FOR AUTOMATIC STARTING

## WESTINGHOUSE COOPER-HEWITT MERCURY RECTIFIER OUTFITS—Continued

## NOTES ON CHARGING LEAD BATTERIES

The instruction book accompanying the battery should be carefully followed.

The ideal conditions for a lead battery are to have it fully discharged before recharging, yet never to have it remain partly discharged. It deteriorates if allowed to remain partly discharged, yet as each charge causes some deterioration, charging ought to be done as infrequently as possible. In practice, these conditions are obviously impossible to obtain. It is advisable to recharge the battery whenever it is likely to remain out of use for some time, and not to recharge it if the amount of charge remaining is sufficient for the prospective run.

**Charge Characteristic**—Battery makers often recommend a high charging rate and a low finishing rate, with one or more steps between. This merely represents a convenient approximation to the ideal charge, the tapering characteristic, as the gradually tapering charge cannot be obtained with most types of charging apparatus. Mercury rectifier outfits produce a tapering charge automatically, and the directions for changing the charging rate may be disregarded.

A constant charging rate, occasionally desirable when a hurry charge is needed, can be obtained by raising the setting of the dial switches as the charge proceeds. No attempt should be made, however,

to operate at a higher current than the rating of the outfit.

**Termination of Charge**—When great precision is required the charge must be stopped when hydrometer, thermometer and voltmeter readings indicate a full charge according to the instructions of battery makers. Where less care is considered necessary, the voltmeter readings alone may be used as a guide, though this method should be checked occasionally by more complete readings, probably at the end of the gassing charge, once every two weeks, at which time it is well to inspect all cells.

A third method, which is still less exact, is to set the rectifier so that it will cease to rectify when the cell voltage is near to maximum possible value. If this is done the rectifier should either be disconnected by hand when the charge is complete or by a time switch. In no case should the ability of the rectifier to drop out at the completion of the charge be relied upon without other means for positively disconnecting it from the circuit. This is necessary because of the fact that both the alternating-current line voltage and the condition of the battery are variable and often unknown.

In case entirely automatic charging is desired, the Westinghouse Time Switch Style No. 152526 must be used to end the main charge at a given hour and to prevent accidental overcharge.

## FREIGHT CHARGES

To the net price of each outfit and low-tension Cooper-Hewitt rectifier bulb delivered by freight in any zone there must be added the amount shown in the price tables.

The price on all shipments f. o. b. cars Works is the net price plus Eastern zone freight. When express shipment is specified by a customer, the price f. o. b. cars Works or warehouse is therefore the net price plus Eastern zone freight, and the price f. o. b. customer's city is the net price plus Eastern zone freight plus express charges.

**Eastern Zone**—The Eastern Zone includes all points on or east of the west bank of the Mississippi River and all territory east of a line beginning at the intersection of a point where the 95th meridian of longitude crosses the headwaters of the Mississippi

River, thence forth on said meridian to the Canadian boundary.

**Central Zone**—The Central Zone includes all points in North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, Texas, Colorado, and points in Minnesota, Iowa, Missouri, Arkansas, and Louisiana west of the Mississippi River, also the Panama Canal zone including the cities of Colon and Panama.

**Western Zone**—The Western Zone includes all points in Arizona, California, Idaho, Montana, New Mexico, Nevada, Oregon, Utah, Washington, and Wyoming.

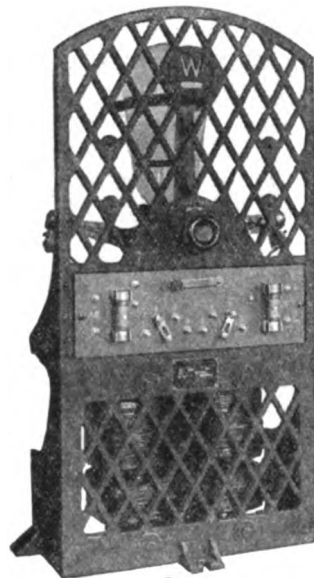
**Hawaiian Islands and Alaska**—Prices for Hawaiian Islands and Alaska are f. o. b. point of ocean shipment (zone freight being added), the ocean freight to be paid by customer.

## DELIVERY

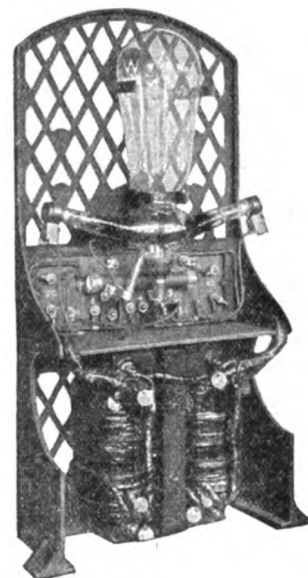
All quotations and sales are f. o. b. cars at zone delivery rates.

## TYPE W RECTIFIER OUTFITS FOR CHARGING VEHICLE BATTERIES

Lead or Edison Cells



FRONT VIEW



REAR VIEW

TYPE W 30-AMPERE RECTIFIER

Type W rectifier outfits are designed to furnish a small, light, inexpensive outfit, for use where frequent adjustment is not necessary, as where the same battery will always be charged.

The type W outfit is not automatic in operation, that is, it will not start itself or stop itself, and if the line voltage fails temporarily the rectifier will not restart itself. To start it the bulb must be tilted by hand by means of the tilting handle.

**Adjustment**—The regulation link connectors controlling transformer taps are provided, by means of which the outfit can be adjusted to deliver approximately normal current to any number of cells within its rating on any line voltage within 10 per cent of normal. The current automatically tapers as the charge progresses, so that the charge finishes at

a low rate as recommended by battery manufacturers.

**Construction**—Type W outfits are so mounted on a solid cast iron frame that the minimum of space is used. The bulb is completely protected from the front as no portion of it extends beyond the frame. The tilting device is easily manipulated, the bulb being returned to normal position by a spring which holds it there during operation.

The starting switch, link connectors, terminals and fuses are mounted on a slate panel on the front of the outfit, easily accessible.

These outfits are suited for floor mounting only and are shipped drilled for the mounting of meters. —Use Style No. 185394, type FW ammeter, and Style No. 185403, type FW voltmeter.

### LIST PRICES AND RATINGS

List price includes outfit complete with one bulb, ammeter and voltmeter. Style number does not include meters.

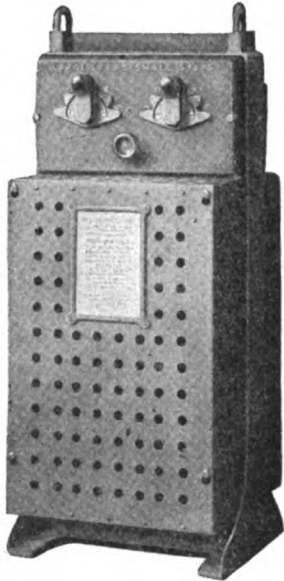
#### 60-Cycle Outfits

Style No.	A-C. Volts	Number of Lead Cells	Number of Edison Cells	D-C. Volts	D-C. Amps.	APPROX. WT., LBS.		List Price	ADD FREIGHT		
						Net	Shipping		Eastern Zone	Central Zone	Western Zone
233907	110	38 to 46	56 to 66	76 to 120	30	190	280	\$270 00	\$6 50	\$16 00	\$27 00
233908	220	38 to 46	56 to 66	76 to 120	30	175	265	270 00	6 50	16 00	27 00

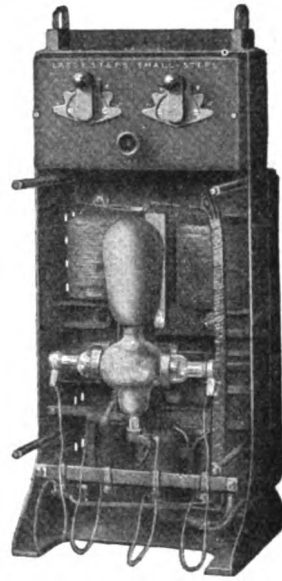
For special ordering instructions see page 1118

Order by Style Number

## TYPES AA AND AN RECTIFIER OUTFITS FOR CHARGING LEAD-CELL VEHICLE BATTERIES



TYPE AA OR AN BATTERY-CHARGING OUTFIT



TYPE AA RECTIFIER, COVER REMOVED

The type AN outfit is not automatic in operation; that is, it will not start itself or stop itself, and if the line voltage fails temporarily, the rectifier will not restart itself. To start it, the bulb must be tilted by hand, by means of a tilting handle.

The type AA outfit has the same features as the type AN and in addition a tilting magnet for automatic starting, and a relay circuit-breaker. In case of a failure of the line voltage, which will stop the rectifier, the cut-out closes the tilting transformer circuit so that the rectifier is ready to restart itself when the voltage is again applied. In case of excessive direct-current the cut-out coil opens the circuit-breaker contacts.

**Charge Characteristic**—The reactance for both types is so designed as to give the proper charge characteristic for lead batteries without changing the position of the dial switches during the charge, if the line voltage remains constant. With proper setting, the charging current tapers off from 30 amperes to 5 or 6 amperes as the battery voltage rises. This feature should not be depended on,

however, to terminate the charge, because of the uncertainties of alternating-current voltage and variations in the condition of the battery. A positive disconnection of the rectifier, either by hand or by means of a time switch, is essential. If the circuit is opened by a time switch and the charge is found to be incomplete, it can be completed in a comparatively short time when attendance is available.

**Adjustment** of voltage or charging current is made by means of the two dial switches, which control the connections to the reactance coil and to both the primary and secondary of the auto-transformer. Part of the reactance is always in series with the primary circuit and acts as a balance, raising the secondary voltage as the current diminishes.

These outfits are enclosed in a properly ventilated iron case and the leads are brought out through suitable bushings. This gives complete protection to the bulb. The rectifier is entirely self-contained and no live parts are exposed.

### LIST PRICES AND RATINGS

Style number and list price include outfit complete with one bulb. Instruments should be ordered as separate items, if desired, or an instrument panel as listed.

#### 60-Cycle Outfits

Style No.	Type	A-C. Volts	No. of Cells	D-C. Volts	D-C. Amps.	APPROX. Net	Wt., Lbs. Shipping	List Price	ADD FREIGHT		
									Eastern Zone	Central Zone	Western Zone
145578	AN	110	14 to 32	28 to 85	30	385	485	\$405 00	\$6 00	\$14 50	\$25 00
145579	AN	220	14 to 32	28 to 85	30	385	485	405 00	6 00	14 50	25 00
145580	AN	110	20 to 44	40 to 120	30	475	575	450 00	6 00	14 50	25 00
145581	AN	220	20 to 44	40 to 120	30	475	575	450 00	6 00	14 50	25 00
145582	AA	110	14 to 32	28 to 85	30	410	520	425 00	6 00	14 50	25 00
145583	AA	220	14 to 32	28 to 85	30	400	510	425 00	6 00	14 50	25 00
145584	AA	110	20 to 44	40 to 120	30	500	600	470 00	6 00	14 50	25 00
145585	AA	220	20 to 44	40 to 120	30	500	600	470 00	6 00	14 50	25 00

For special ordering instructions see page 1118

Order by Style Number

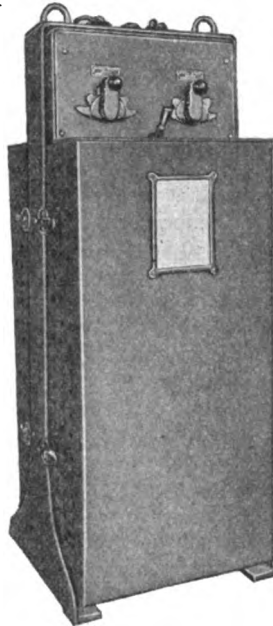


## TYPE AT RECTIFIERS

### FOR CHARGING TELEPHONE AND TELEGRAPH BATTERIES

#### Telephone Rectifiers

All telephone exchanges require a source of direct current to charge the power battery. It is desirable that the charging equipment be such as to permit the batteries to be charged while in use which means that pulsations in the charging current must be kept at a minimum value. Further it is essential that the telephone lines be insulated from the power lines. The type AT rectifiers meet both of these requirements by the use of a large amount of sustaining inductance in the direct current circuit, and by the use of insulating transformers instead of auto-transformers.



50-AMPERE OUTFIT

#### Telegraph Rectifiers

For obvious reasons it is not essential to keep the pulsations in the charging current at a minimum value as in the telephone rectifiers and, therefore, instead of having a separate coil of sustaining inductance, this feature is incorporated in the transformer winding. Aside from this exception the telephone and telegraph rectifiers are similar.

#### General Construction for Floor Mounting Rectifiers

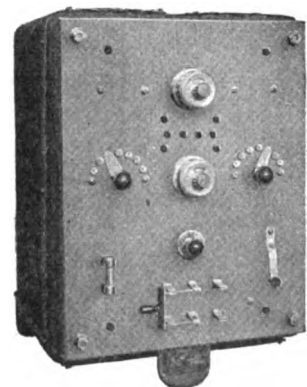
These rectifiers are built around a central cast iron frame, which carries the transformer, sustaining and reactance coils, dial switches and other details. Cast iron covers enclose the top part of the rectifier, the front cover also serving as a support for the dial switch star plates and regulating handles. Perforated sheet steel covers extend from the top cast covers to the feet of the outfit, completely enclosing all parts. The rectifier is entirely self-contained and no live parts are exposed. All leads are brought out through porcelain bushings located in the top rib of the rectifier frame. All exterior surfaces of the frame and covers have a black gloss finish and all other parts, other than working

surfaces, are polished or painted with a durable black coating of good appearance.

#### Description

**10 Ampere—8 and 11 Cell Outfit**—This rectifier is a panel type and the only type AT arranged for wall mounting. A slate panel, carrying the control switches, meters, line switch, bulb, etc., is mounted together with the transformer and sustaining coil on a frame arranged for wall mounting. Electrically, the outfit is similar to the larger sizes of this type, except that the standard outfit is for 8 to 11 cells. The panel is drilled and wired for meters. Two four-point dial switches are provided for current control and snap switches for the alternating current and direct current lines. Link connections are provided whereby the transformer connection can be changed for operation on either 110 or 220 volt, 60 cycle circuits. A special knife switch is provided which is used to transfer the ammeter from the direct current circuit of the outfit to the load circuit, thus permitting the reading of both charge and discharge current when the battery is floating on the line. This outfit is not supplied for automatic starting.

**10 Ampere—66 Cell Outfit**—This rectifier will charge a 66 cell battery at a rate of 10 amperes d-c. and a range of d-c. voltage from 130 to 180. It will operate on either 110 or 220 volt, 60-cycle circuit by changing the link connections on the dial switch panel to suit. Current control is by means of one three-point and one five-point dial switch. It is non-automatic in starting and the bulb must be tilted by means of a hand-operated tilting device. An alarm relay, operated by the rectified current, provides a means for notifying the operator when the rectifier is shut down or when it is properly charging. This rectifier should not be applied in telephone service for charging the batteries while they are in use as the inductance in the sustaining coil is not sufficient to properly smooth out the ripples.



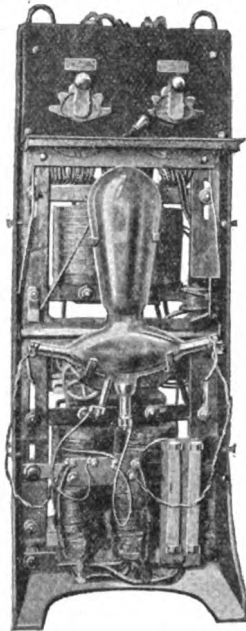
10-AMPERE OUTFIT

**30 Ampere—17-11 Cell Outfit**—This outfit will charge a 17 cell battery at a rate of 5 to 30 amperes d-c. when used with a line voltage of either 110 or 220 volts, 60 cycles. The general appearance of the

TYPE AT RECTIFIERS—Continued

30 ampere rectifier is practically the same as that of the 10 ampere, 66 cell outfit. Taps are provided for 11 cells, but with this number there will not be a uniform progression of current steps as the dials are notched up one step at a time. It is non-automatic in starting and is equipped with a combined starting switch and bulb tilting mechanism operated by a common handle. It has sufficient sustaining inductance to allow the battery to be floated on the rectifier.

**50 Ampere—11-25 Cell Outfit**—This rectifier is rated at 50 amperes and is capable of charging from 11 to 25 cells in series. It is adapted for use on either 110 or 220-volt, 60-cycle service by means of connecting the halves of the transformer primary in multiple or series. Two five-point dial switches, which control taps of the transformer secondary, provide control for the number of cells in the battery and for the desired charging current. This rectifier is of the automatic type, being equipped with a single phase induction motor arranged with the



TYPE AT RECTIFIER  
COVER REMOVED

necessary gears and cranks which automatically tilts the bulb when starting. In addition to this automatic feature they are equipped with a three-element relay, one element of which operates the tilting motor, another controls the starting circuit and the third one is arranged to operate in the alarm circuit, to give the alarm in case of power failure or any trouble with the rectifier. A similar outfit is also furnished for use on either 110 or 220 volts, 50 cycle circuits.

**15 and 30 Ampere, 120 Cell Telegraph Rectifier**—These rectifiers were designed for charging telegraph batteries at a current range of 5 to 15 amperes for the 15 ampere size and a range of 7½ to 30 amperes for the 30-ampere size. In common with the telephone outfits, they are provided with link connections to adapt them for use on either 110 or 220 volts, 60 cycle circuit. They are suitable for one number of cells only, i.e. 120 cells, but will cover a voltage range of from 240 to 320 volts d-c. These rectifiers are non-automatic and to start them it is necessary to operate both the starting switch and the bulb tilting handle. Five positions are provided for the large step dial switch and three positions for the small step dial switch. As the inductance of the sustaining coil is only large enough to keep the outfit properly operating at the lower current values, they should not be applied where so-called noiseless charging is desired. However, in telegraph service noiseless charging is obviously unnecessary and these rectifiers perform satisfactorily the service for which they were designed. A series coil type of alarm relay is mounted on the cross rib of the rectifier frame on each outfit.

LIST PRICES AND RATINGS

Style number and list price include outfit complete with one bulb. Instruments should be ordered as separate items, if desired, or an instrument panel as listed.

Style No.	D-C. Amps.	D-C. Volts	A-C. Volts	Cycles	APPROX. WT. LBS.			List Price	ADD FREIGHT			
					No. of Cells	Net	Shipping		Eastern Zone	Central Zone	Western Zone	
<b>Non-Automatic*</b>												
220241	10	16 to 30	110 or 220	60	8 to 11	385	485	\$250 00	\$6 00	\$22 50	\$36 65	
220246	30	22 to 45	110 or 220	60	17 to 11	425	535	490 00	6 00	22 50	36 65	
312207	15	240 to 320	110 or 220	60	120	637	740	750 00	6 00	22 50	36 65	
312208	30	240 to 320	110 or 220	60	120	872	977	1150 00	6 00	22 50	36 65	
356896	10	130 to 180	110 or 220	60	66	550	650	460 00	6 00	22 50	36 65	
<b>Automatic†</b>												
300305	50	22 to 65	110 or 220	60	11 to 25	870	1000	720 00	6 00	22 50	36 65	
356897	50	22 to 65	110 or 220	50	11 to 25	950	1100	900 00	6 00	22 50	36 65	

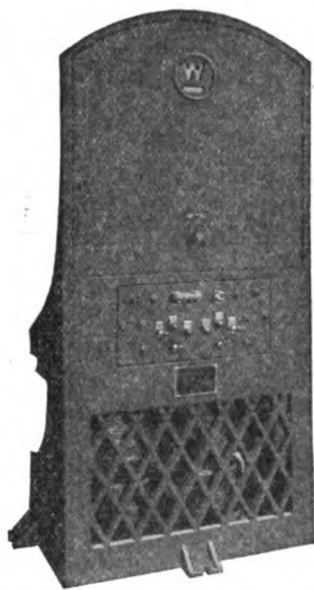
\*In starting it is necessary to operate the bulb tilting device by hand.

†Equipped with a single phase induction motor which automatically tilts the bulb when the alternating current is applied.

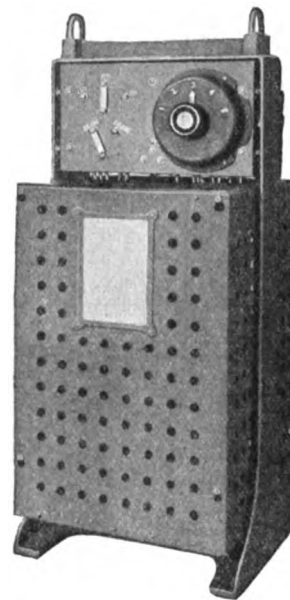
Order by Style Number

## TYPES AL AND WL RECTIFIER OUTFITS

### FOR MOTION PICTURE PROJECTION



TYPE WL RECTIFIER



TYPE AL RECTIFIER

The motion picture industry now recognizes the advantages of direct current over alternating for arc lamps for projection work. The greater ease of focusing, greater light efficiency, less delicate and hence less frequent adjustment of carbons, steadier light, greater economy of carbons, greater maximum light intensity and decreased breakage of condenser lenses are established advantages.

Where the supply is alternating current, the mercury arc rectifier is the most compact, least expensive and most efficient form of converter.

Two types are offered. The type AL outfit is the earlier form, which includes a dial switch for

control of arc current and in which all parts are totally enclosed. In the type WL outfit these two features are eliminated for the sake of simplicity and lower first cost. Both are automatic in starting, both are equipped with ready means for operating the arc on alternating-current in case of temporary lack of a bulb, and in both regulation is automatically accomplished without loss of power by means of reactance. While the type WL outfit at a very much lower first cost has a higher efficiency, about 72 per cent, and a higher power factor, about 70 per cent, the type AL outfit still has application because of its greater flexibility and because all parts are enclosed.

#### LIST PRICES AND RATINGS

##### 60-Cycle Outfits

##### Type AL

Style No.	D-C. Amps.	D-C. Volts	A-C. Volts	APPROX. WEIGHT, LBS.		List Price	ADD FREIGHT		
				Net	Shipping		East Zone	Cent. Zone	West Zone
111125	30	55	110	510	610	\$435 00	\$8 00	\$14 50	\$25 00
111126	30	55	220	510	610	435 00	8 00	14 50	25 00
186049	40	55	110	800	1000	520 00	8 00	14 50	25 00
186050	40	55	220	800	1000	520 00	8 00	14 50	25 00
186051	50	55	110	800	1000	575 00	8 00	14 50	25 00
186052	50	55	220	800	1000	575 00	8 00	14 50	25 00

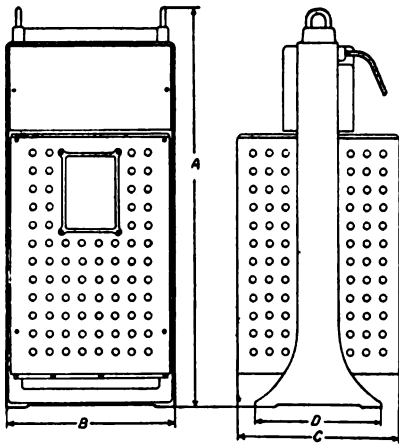
##### Type WL

252894	30	55	110	250	350	275 00	4 50	8 50	18 00
252895	30	55	220	250	350	275 00	4 50	8 50	18 00
252896	40	55	110	325	425	400 00	4 50	8 50	18 00
252897	40	55	220	325	425	400 00	4 50	8 50	18 00
252898	50	55	110	350	450	415 00	4 50	8 50	18 00
252899	50	55	220	350	450	415 00	4 50	8 50	18 00

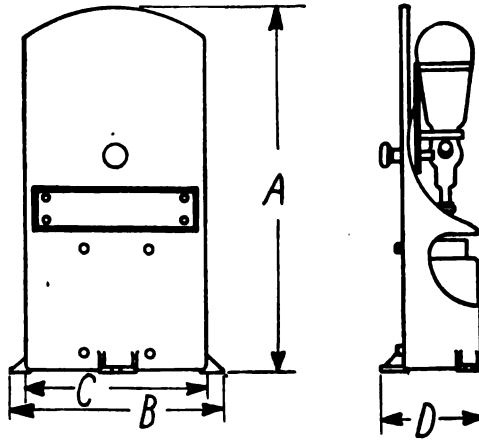
For special ordering instructions see page 1118

Order by Style Number

OUTLINE DIMENSIONS

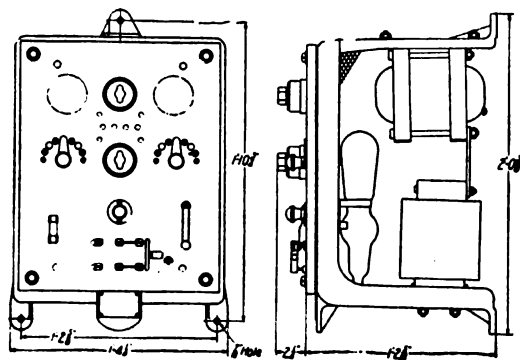


TYPES AA, AE, AL, AN AND AT



TYPES W AND WL

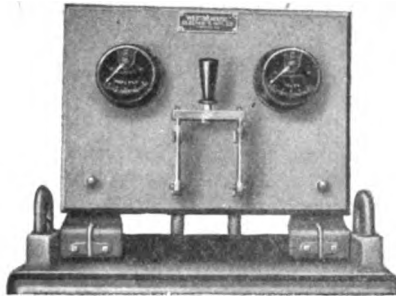
Type	Style No.	DIMENSIONS IN INCHES				Type	Style No.	DIMENSIONS IN INCHES			
		A	B	C	D			A	B	C	D
AA	145582	44 1/4	18 3/4	18 3/4	16	AT	220241	22 1/2	16 1/4	14 1/2	
AA	145583					AT	220246	44 1/2	18 3/4	18 1/2	16
AA	145584					AT	300305	56 3/4	21	20 3/4	20
AA	145585										
AL	111125	44 1/4	18 3/4	18 3/4	16	AT	312207	49 1/2	22 3/4	18 1/4	14
AL	111126					AT	312208	49 1/2	21	20 3/4	20
AL	186049	56	21 1/4	21 1/4	18	AT	356896	49 1/2	21	20 3/4	20
AL	186050					AT	356897	56 3/4	21	20 3/4	20
AL	186051					W	225658	27 1/2	15 1/2	13	7 3/4
AL	186052					W	225659	34 1/2	19 1/2	17	8 3/4
AN	145578	44 1/4	18 3/4	18 3/4	16	WL	252694	45	23 3/4	21	11 1/2
AN	145579					WL	252695	36	20 3/4	18	12 3/4
AN	145580					WL	252696				
AN	145581					WL	252697				
						WL	252698				
						WL	252699				



TYPE AT 10-AMP. STYLE No. 220241

These dimensions are for reference only; for official dimensions apply to the nearest district office.

## ACCESSORIES FOR RECTIFIER OUTFITS



INSTRUMENT PANEL

### INSTRUMENT PANEL

Measuring instruments are not supplied regularly with rectifier outfits because most electric vehicles are equipped with meters that are sufficiently accurate for charging purposes. Where meters are required with any of the type A rectifiers, an instrument panel should be ordered. This is a neat slate panel equipped with a type AW ammeter, a type AW voltmeter, and a double-pole switch, arranged to be attached to the top of the frame of any of these outfits. The panel may be purchased separately and mounted after the rectifier is installed if desired.

### TIME SWITCH

Where batteries are to be charged at night or at times when attendance is not available, a time switch should be used to terminate the charge at a predetermined time. In case it is found that the charge is



TIME SWITCH

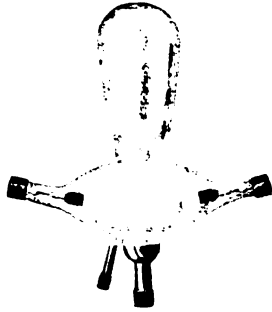
not complete, it can be completed in a comparatively short time when attendance is available. The switch consists of a 75-ampere type F carbon-break circuit-breaker enclosed in a cast-iron case and arranged to be tripped by the alarm mechanism of a clock.

Style No.	Description	List Price
124967	Meter panel for Style Nos. 220243, 220244, 220245, 220246, 145578, 145579, 145582, 145583, 111125 or 111126	\$35 00
124968	Meter panel for Style Nos. 145580, 145581, 145584 or 145585	35 00
152526	Time switch for use with all types of rectifier outfits.	14 00

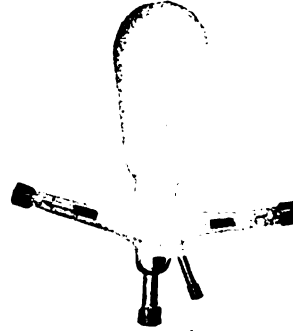
Order by Style Number

## RECTIFIER BULBS AND RENEWALS

The guaranteed average life of the bulb under normal operating conditions is 400 working hours.



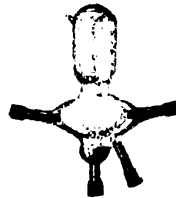
30 AMPERES  
STYLE No. 157957



30 AMPERES  
STYLE No. 231580



10 AMPERES  
STYLE No. 222324



5 AMPERES  
STYLE No. 125185



30 AMPERES  
STYLE No. 321055

### SPECIFICATIONS AND LIST PRICES

Style No.	Description	List Price	ADD FREIGHT		
			Eastern Zone	Central Zone	Western Zone
125185	Bulb for type E outfit, Style No. 152999	\$10 00	\$0 75	\$1 50	\$3 00
125186	Bulb for type E outfit Style No. 154611, 222305 and 7,220241	11 00	75	1 50	3 00
222324	Bulb for type E outfits Style No. 222306 and 8	11 00	75	1 50	3 00
222323	Bulb for 15-ampere type W and AT outfit	14 00	75	1 50	3 00
231580	Bulb for 30-ampere type W outfit	21 00	75	1 50	3 00
157957	Bulb for 30-ampere type AA, AN, or 20 and 30-ampere type AT outfit	21 00	75	1 50	3 00
114847	Bulb for 50-ampere type AE or 40 and 50-ampere type AT, AL and WL outfit.	37 00	75	1 50	3 00
321055	Bulb for 15-ampere and 30-ampere type AT outfits Style No. 312207 and 312208	45 00	75	1 50	3 00

### SPECIAL ORDERING INSTRUCTIONS

Complete information regarding the source of supply and the type and size of battery to be charged, or the nature of the load if not a battery, should be furnished when ordering a rectifier.

Outfits as listed in this catalogue are for use on 60-cycle circuits except type AT Style Number

356897 for use on 50 cycles. Similar outfits can be furnished for other frequencies on application.

**Time Switch**—The time switch for terminating the charge at a definite hour should always be ordered when automatic termination of charge is desired.

*Order by Style Number*

## WESTINGHOUSE RECTIGON BATTERY-CHARGERS

### Application

Westinghouse Rectigons are suitable for use wherever direct current is required for battery charging. The source of supply must be alternating current within the limits of the voltage and frequency ratings.

At the present time Rectigons are made with a maximum capacity of 12 amperes, and 75 volts direct current. Future developments will probably provide outfits with both higher current and higher voltage ratings. The outfits are for the most part half-wave outfits delivering a very rapidly pulsating direct current. Wherever this may result in chattering of magnets, the application should not be made. The Rectigon should not be applied on telephone batteries while the batteries are in service on account of the noise induced in telephone lines.

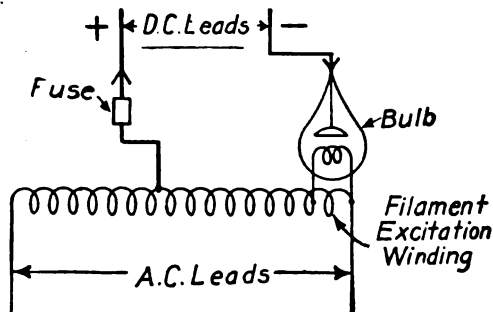


FIG. 1—HALF-WAVE RECTIGON  
SCHEMATIC DIAGRAM OF CONNECTIONS

The largest present application for the Rectigon Battery-Charger is automobile battery charging. This field is ever increasing with the enormous popularity of automobiles, since practically all automobile batteries need occasional charging. Wherever small batteries are to be charged from alternating current the Rectigon can usually be used. Examples of such applications are found in alarm systems, in battery-operated signal systems on railroads, in stations where miners' lamp batteries are recharged, and in telephone installations where one battery is charged while a duplicate is in service. The Rectigon can also be used to supply current for electro-plating.

### Distinctive Features

Among the chief advantages which the Rectigon has over other apparatus used for the same purpose are the following:

Starts operating automatically as soon as the direct-current leads are connected to load, and alternating-current supply is turned on.

Fool-proof: no oil, no grease; no moving parts to get out of order or replace on account of wear.

Lower first cost due to decreased number of parts such as starting devices, sustaining coils, resistance, etc.

Efficiency of garage type outfit where operating at full capacity is higher than other apparatus.

No need to remove batteries from car when using a portable unit.

No knowledge of electricity is necessary to use the outfit effectively.

Absolutely impossible to have current reversal from batteries.

For the current and voltage values given under each type, Rectigons are superior to mercury arc rectifiers because they are inherently self-starting. As soon as the line voltage is applied, the outfit is ready to operate and the load current will flow whenever the circuit is closed.

It is practically impossible for any part of the apparatus, other than the bulb, to get out of order while in service. The bulb, of course, requires periodical renewals, but its life is long and fairly uniform, so that the expense and trouble of renewals is slight.

### Principle of Operation

The outfits consist essentially of a transformer for converting the voltage to the proper value, and a bulb for rectifying. The bulb is a glass envelope, containing an anode and a cathode in the shape of a filament, surrounded by an atmosphere of pure Argon. Leads to the anode and cathode are sealed through the glass walls of the bulbs. For convenience of installation, the filament leads are connected to the terminals of a screw base. When alternating-current voltage is applied to the transformer, the filament of the bulb is heated to incandescence by current from a special winding on the transformer. At incandescent temperature, the filament emits electrons which, by collision with the molecules of the gas, ionize the gas and provide the

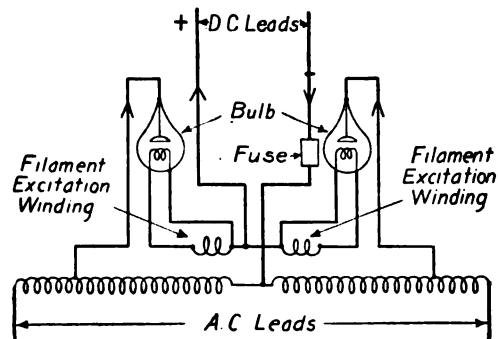


FIG. 2—FULL-WAVE RECTIGON  
SCHEMATIC DIAGRAM OF CONNECTIONS

means of current flow from the anode to the cathode. Since the anode remains at a comparatively low temperature, current cannot flow in the reverse direction.

The voltage of the secondary of the transformer is applied to the load through the bulb and due to

## WESTINGHOUSE RECTIGON BATTERY-CHARGERS—Continued

the valvelike action of the bulb, current is permitted to flow in only one direction. None of the Rectigons listed in the following pages will shut off automatically when the batteries are fully charged.

**Construction**

All of the Rectigons have been designed with a view to making them strong, simple and attractive in appearance.

charging 3 cells the current will be approximately 20 per cent above the rated value, and with a line voltage 10 per cent below normal and charging 6 cells the current will be approximately 50 per cent of the rated value. The charging current does not vary appreciably during charge.

These outfits should not be applied except on 60-cycle, 110-volt lines, but outfits for other frequencies and for special line voltages can be furnished.

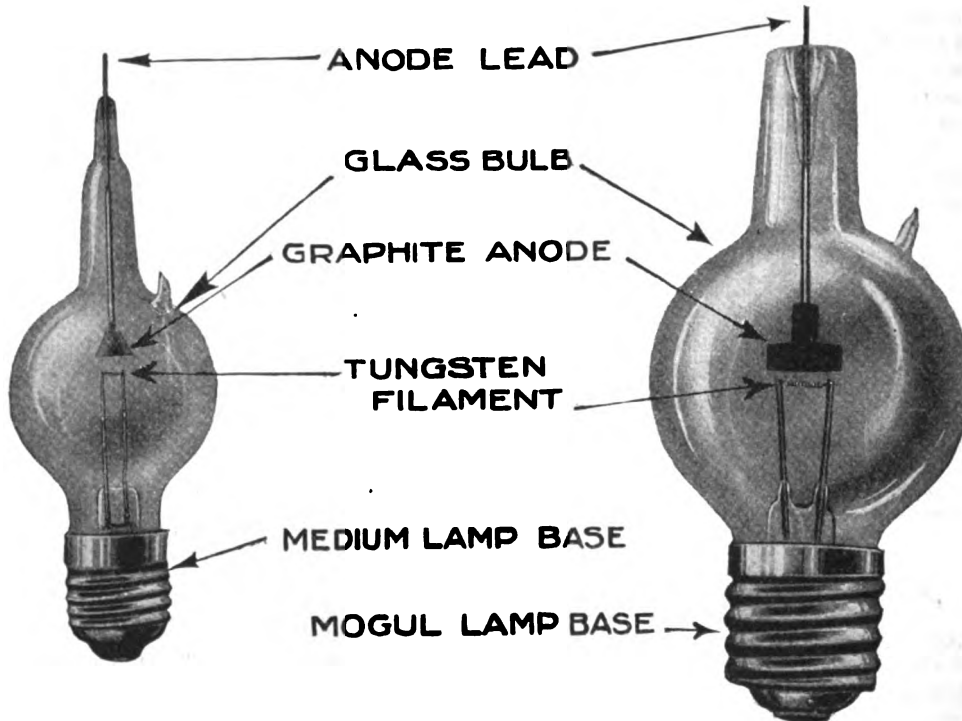


FIG. 3—2-AMPERE BULB, STYLE No. 277681

FIG. 4—6-AMPERE BULB, STYLE No. 289416

**Rectigons for Car Owners**

The small portable rectigons designed to charge single batteries in private garages are made as simple as possible and at the same time rugged and good looking.

In these outfits the transformer secondary voltage and internal reactance are so chosen to give a charging current not far from the rated values under any conditions of line or battery within reasonable limits without any change in connections or any adjustment for different conditions. The application is limited to lines of voltage between 90 and 110 per cent of normal and to batteries of between 3 and 6 cells. Within these limits the charging current varies from 20 per cent above the rated value to about 50 per cent below. Thus, with a line voltage 10 per cent above normal and

The efficiency of these outfits varies between 30 and 50 per cent, dependent on the load voltage, but even with this low efficiency the total cost of a complete charge is very low compared to the cost of a charge at a garage or service station. With power at 10 cents per kilowatthour, the 2-ampere outfit, Style No. 282395, costs approximately 1 cent per hour for power, and the 6-ampere outfit, Style No. 285168, about 2½ cents per hour. On the basis of 800-hour bulb life, which is below the average life secured in service, the total cost of operation is about 1½ cents per hour for the small outfit and 3½ cents for the large outfit.

**Rectigons for Garages and Service Stations**

In the 6 and 12-ampere 75-volt Rectigon, for use in garages and service stations, great flexibility of control has been provided to make it applicable to



## WESTINGHOUSE RECTIGON BATTERY CHARGERS—Continued

any possible demands within the limits of the capacity and at the same time simplicity and good appearance have been retained.

The internal reactance which limits the current in the smaller outfits has been replaced by separate coils, and a single dial switch for current control, meters and a snap switch have been added. With these outfits, rated current, or less if desired, can be delivered to any number of cells from 3 to 60 from any line within 10 per cent of normal voltage. The power factor is practically constant at about 50 per cent.

For installations where the business is too great to be handled by one rectigon, two or several may be installed; but, since the outfits will not operate in parallel, the direct-current leads should not be connected together, but a separate load circuit used for each outfit. In such installations it is well to reverse the alternating-current connections of alternate outfits so that the power taken from the line will be balanced. Proper connections as indicated by Fig. 5 show the 6-ampere, 75-volt outfit in service. These same instructions apply to multiple installations of the 12-ampere, 75-volt outfits.

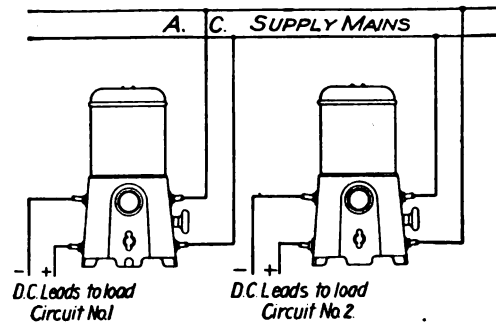
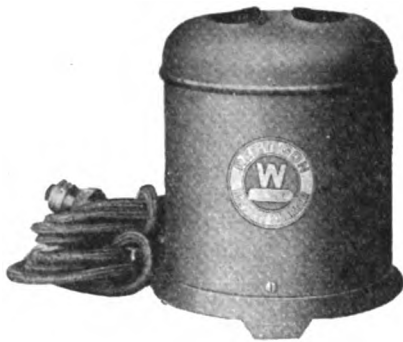


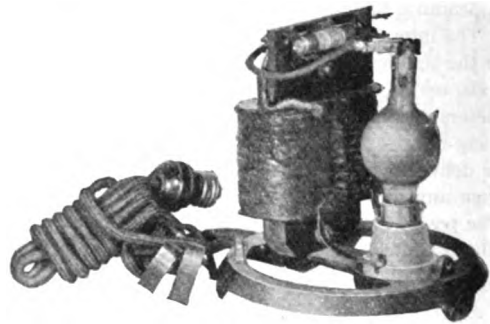
FIG. 5—DIAGRAM OF CONNECTIONS FOR TWO 6-AMPERE, 75-VOLT RECTIGON OUTFITS

NOTE—The load circuits must be kept separate.

## RADIO-TYPE RECTIGON



THE COMPLETE RECTIGON WITH COVER



RECTIGON WITH COVER REMOVED SHOWING ALL PARTS

**Application and Construction**—This new type of rectigon has been designed primarily to charge the 11-cell storage batteries now being put on the market by different manufacturers. This battery, which is used to supply the plate voltage for vacuum tube receiving sets, delivers approximately 22 D.C. volts, and the rectigon has been so constructed that it will give a charge of approximately .2 ampere at normal line voltage.

In size and appearance the apparatus is identical with Style Number 282395, uses the same bulb, Style Number 277681, and embodies the same principles of rugged construction which characterize the complete line of rectigon battery chargers. The few minor changes necessary to make this apparatus suitable for its specific application are given below.

Although this rectigon has been designed primarily to charge the 11-cell storage battery, it has also been supplied with a tap in the transformer winding which will enable the user to charge either a 3 or 6-cell battery at approximately 2½ amperes to a 3-cell and 1½ amperes to a 6-cell battery. At the top of the transformer as shown in the cut is mounted a fuse block which is so arranged that when the fuse is in the extreme left position, the rectigon will charge an 11-cell storage battery at approximately .2 ampere and when in the extreme right position will charge a 3 or 6-cell battery at the specified rate. The fuse arrangement is such that only one fuse can be inserted at a time, thereby eliminating the possibility of wrong connection.

**Installation and Operation**—As this type of rectigon is similar to the private garage type outfit, it is operated in the same manner. To start, simply clasp the battery clips over the terminal on the

battery and turn the key in the lamp socket. To stop charging, turn off the A.C. supply and disconnect the battery.

Inasmuch as this rectigon is of the auto transformer type, it should not be used while the radio battery is in operation, and before being operated care should be taken to disconnect the radio "B" battery from the receiving apparatus. This same precautionary measure applies when charging the "A" or filament battery.

**Convenience**—The application of the radio rectigon is threefold. It can be used to charge either the 11-cell plate battery, the 3-cell filament battery, or, if so desired, an automobile starting and lighting battery by merely placing the fuse in the proper set of fuse clips. Each outfit is shipped with an instruction card which gives full and complete instructions for operation and indicates plainly the fuse position for charging a given type of battery.

The same features of portability, superior finish and workmanship, absence of oil or grease, and automatic operation of this type of rectigon which have been distinctive features in our private garage type outfits are all incorporated in this new apparatus.

**Cost of Operation**—With power at 10 cents a kilowatt-hour the cost of operating this rectigon is approximately ½ cent per hour, which is practically negligible considering the benefits derived from the use of such a piece of apparatus. The bulb expense is minimized by the fact that the bulbs give a long life and renewals are very infrequent. This item of expense, together with the power cost, are the only two which enter into the cost of operation as there are no moving parts to wear or get out of order.

### LIST PRICES AND RATINGS

Style number and list price include outfit complete with bulb.

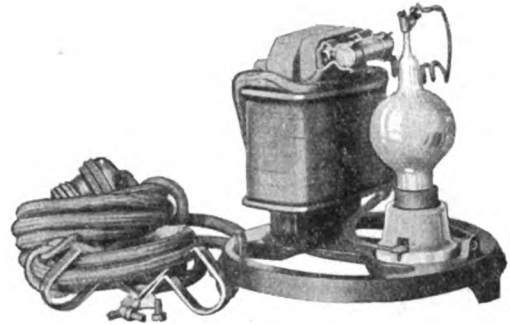
Style No.	A-C. Volts	Cycles	No. of Cells	D-C. Volts	D-C. Amps.	APPROX. WEIGHT, LBS.		List Price
						Net	Boxed	
332722	115	60	3 to 11	7¼ to 27¼	2 to ¼	9	9¼	\$19 50
Renewal Bulb Style No.		Ampere Capacity		Bulb Net Weight		Bulb List Price		
277681		2 Maximum		2 oz.		\$4 00		
Renewal Fuse Style No.		Ampere Capacity				List Price		
37158		6				*		

\*For fuse see section on General Wiring Devices.

## PRIVATE GARAGE RECTIGON OUTFITS



THE COMPLETE RECTIGON WITH COVER



RECTIGON WITH COVER REMOVED SHOWING ALL PARTS

**Application and Construction**—Private garage Rectigon outfits are for the use of the car owner who wants to charge his own batteries.

Although the 2-ampere Rectigon is too small to put a full charge into the ordinary size starting and lighting battery in a single night, it is, nevertheless, to be recommended for giving a battery a soaking charge, in order to keep the sulphate from accumulating on the plates. Due to the low charging rate, this outfit will not damage the battery if left on for an indefinite period after the battery has become fully charged. Should the battery become entirely discharged, the 2-ampere size, if left on for 12 hours, will put enough life into it to enable the car owner to start the car the next morning. This size outfit is particularly adaptable for charging storage batteries on motor cycles, which use a smaller capacity battery than the average automobile.

Where a higher charging rate is required, in order to charge the battery in a shorter length of time, the 6-ampere outfit is recommended, but care must be used in the operation of this outfit as the 6-ampere rate will tend to heat up the batteries if left on after the battery has become fully charged.

**Safety**—A fuse, which is placed in the direct-current circuit for protection against overload due to the reversal of battery polarity, is mounted at the top of the transformer. A 6-ampere fuse is supplied with the 2-ampere outfit, and a 15-ampere fuse is supplied with the 6-ampere outfit.

**Installation and Operation**—Due to the fact that the private garage-type outfits are portable, they may be set on any convenient bench or on the running board of an automobile. To start the outfit, it is simply necessary to clasp the battery clips over the terminals and turn on the key in the socket, and the charging will begin. To stop charging, turn off the alternating current and disconnect the battery.

**Finish**—The base casting is black and the cover a glossy maroon. This finish besides being attractive in appearance is durable and easily kept clean.

**Economical**—The cost of charging batteries with the Rectigon is very low compared with the charge made by most public battery-charging stations. In addition the convenience which the Rectigon offers the private owner is well worth considering.

### LIST PRICES AND RATINGS

#### Style Nos. and Characteristics as follows:

Style No.	D-C. Amps.	D-C. Volts	A-C. Volts	Cycles	No. of Cells	APPROX. WT., LBS.		List Price
						Net	Boxed	
282395	2 to 1	7½ to 15	115	60	3 to 6	9	9¼	\$18 00
321395	2 to 1	7½ to 15	115	25	3 to 6	20	22	28 00
329216	2 to 1	7½ to 15	230	60	3 to 6	20	22	27 00
356398	2 to 1	7½ to 15	115	50	3 to 6	18	20	22 00
285168	5 to 3	7½ to 15	115	60	3 to 6	18	21	28 00
350743	5 to 3	7½ to 15	115	50	3 to 6	20	22	34 00

#### Renewal Bulb

Rectigon Style No.	Bulb Style No.	Ampere Capacity	Net Weight Ounces	List Price
282395 } 321395 } 329216 } 356398 }	277681	2	2	\$4 00
285168 } 350743 }	289414	5	5	8 00

#### Renewal Fuse

Rectigon Style No.	Fuse Style No.	Ampere Capacity	List Price
282395 } 321395 } 329216 } 356398 }	37158	6	*
285168 } 350743 }	37162	15	*

\*For fuses see Section on General Wiring Devices.

Order by Style Number

14-304A

## TELEPHONE RECTIGON OUTFIT



THE COMPLETE RECTIGON WITH COVER ON



RECTIGON WITH COVER REMOVED, SHOWING ALL PARTS

**Application**—This outfit is designed for use in small telephone exchanges which are located some distance from the central office or where it is impractical to charge the batteries through trunk lines from the central office.

**Operation**—Although this outfit rectifies both half-waves, it is not noiseless. Batteries can not be charged with this outfit while connected to the telephone line as an objectionable noise would be introduced in the talking circuit. It is recommended for use only where duplicate batteries are installed so that one battery is charged while the other is being used. This outfit is well suited to the charging of small batteries because of the compact arrangement of the parts, small size, neat appearance, freedom from all chance of trouble due to moving parts, inherent self-starting with the application of line

voltage, high efficiency compared to other low-voltage equipment and low cost.

**Construction**—In construction the telephone type Rectigon is similar to the ones designed for private garage charging. It has the same outside dimensions as the 6-ampere 15-volt outfit and is likewise portable. Being a full-wave rectifier it uses two 30-volt bulbs. The transformer is of the insulating type and the reactance is made very high so that the charging current varies only slightly as the battery becomes charged.

**Installation**—Since this Rectigon is small in size, it can be located at any convenient point. The alternating-current lead is furnished with a separable attachment plug and the direct-current lead is tinned for connection to the battery circuit.

### LIST PRICES AND RATINGS

Style number and list price include outfit complete with two bulbs.

Style No.	A-C. Volts	Cycles	No. of Cells	D-C. Volts	D-C. Amps.	APPROX. Wt., Lbs.		List Price
						Net	Boxed	
289417	110	60	11	30	3	18½	21	\$45 00

#### RENEWAL BULBS (Two required)

Style No.	Ampere Capacity	Net Wt.	List Price
289415	1½	5 oz.	\$4 00

#### RENEWAL FUSES

Style No.	Ampere Capacity	List Price
37156	4	†

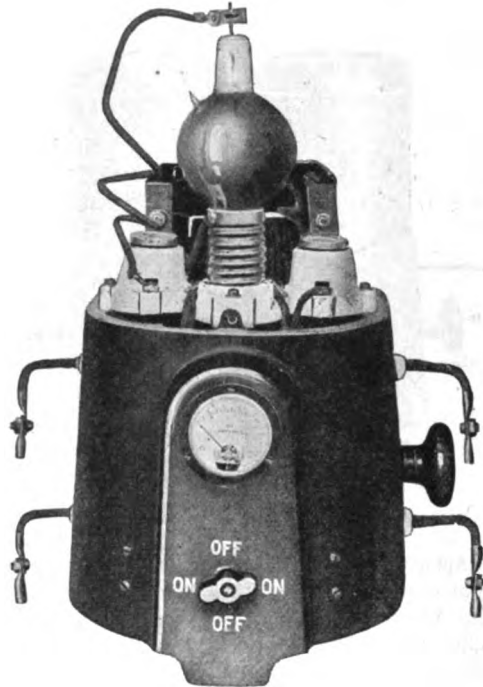
†For fuses, see page 52.

Order by Style Number

## 6-AMPERE, 75-VOLT RECTIGON OUTFIT FOR PUBLIC GARAGES AND BATTERY SERVICE STATIONS



RECTIGON, COVER ON



RECTIGON, COVER REMOVED, SHOWING PARTS

**Application**—The Westinghouse Garage Type Rectigon for charging, starting, lighting, and ignition batteries affords an extremely flexible equipment for garage and service stations where the number of batteries to be charged is variable.

**Operation**—The simplicity of the Rectigon will make a strong appeal to the garage owner, as a special attendant is not necessary. The outfit is started by merely turning on the snap switch, and adjusting the dial switch to obtain the proper current for the number of batteries being charged.

There is no danger in case of line failure; the batteries cannot discharge, and, as soon as the line voltage is restored, the outfit will automatically resume operation.

**Construction**—All parts are mounted on a cast iron base and are protected by the base and by a pressed steel cover which can be readily removed to permit replacement of fuses or bulb. Both the alternating-current and direct-current circuits are protected against overloads and short-circuits by means of 15-ampere plug fuses which can be quickly replaced.

A flush-type BX ammeter, mounted on the front of the base, indicates the current output on the direct current or battery side. Below the ammeter is a snap switch, which controls both the direct-current and alternating-current circuits. On the right hand side is a dial switch handle for controlling the direct current.

Leads for the alternating current and direct current are brought out on opposite sides of the base and are plainly marked.

**Installation**—One man can install the Rectigon. It can be placed on a bench, or mounted on the wall by means of two strap hangers, which are furnished with it. These hangers are screwed to the wall and hook into the back of the base casting, holding the Rectigon firmly in place. There are only four wires to be connected and these connections are clearly indicated.

**Economy**—Combined with this saving in labor is a very low current consumption which makes the Rectigon exceedingly economical in operation and gives the garage or service station a large margin of profit on its battery-charging business.

### STYLES AND CHARACTERISTICS

Style No.	A-C.		No. of Cells	D-C.		APPROX. WT., LBS.		List Price
	Volts	Cycles		Volts	Amps.	Net	Boxed	
296304	115	60	3 to 30	6 to 75	6	55	85	\$130 00
332976	115	50	3 to 30	6 to 75	6	55	85	140 00

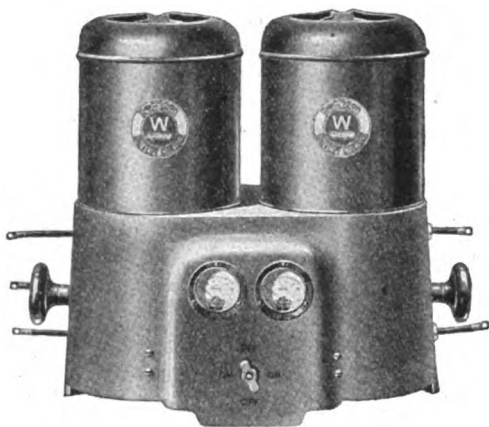
#### RENEWAL BULB

Rectigon Style No.	Bulb Style No.	Ampere Capacity	Net Weight Ounces	List Price
296304 } 332976 }	289416	6	5	\$8 00

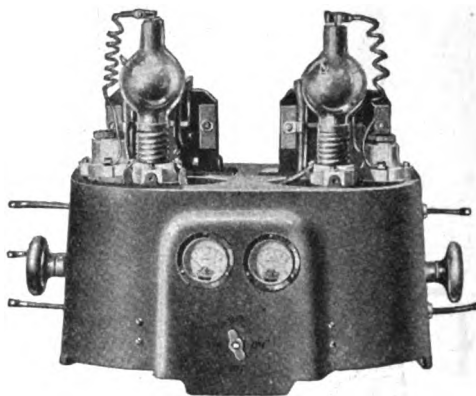
#### RENEWAL FUSES (Two Required)

Rectigon Style No.	Fuse Style No.	Ampere Capacity	List Price
296304 } 332976 }	222030	15	On Request

## 12-AMPERE, 75-VOLT RECTIGON OUTFIT FOR LARGE GARAGES AND BATTERY SERVICE STATIONS



RECTIGON WITH COVER ON



RECTIGON WITH COVER REMOVED

**Application**—The 12-ampere 75-volt Rectigon is similar in application to the 6-ampere 75-volt outfit, but has twice the capacity of the smaller size. This unit is flexible in control, and, because of its simplicity, is easy to operate.

**Operation**—By means of the arrangement of the direct-current leads, the user is given the choice of three combinations for charging batteries, as there are always two circuits available. The first combination will charge two groups, of from one to ten batteries each, at a six-ampere rate. Or, by simply turning the regulating handle to the off position, it is possible to eliminate one group. A second rearrangement of the external connections permits one to charge a maximum of ten batteries at the rate of 12 amperes. The third combination is an arrangement of batteries into three groups so that the current going into one group will equal the sum of the currents in the other two groups. In this manner it is possible to give a high charging rate to a special group of batteries and at the same time charge two other groups at a low rate.

**Construction**—This Rectigon in appearance and construction resembles the smaller unit of this type. A snap switch mounted on the front of the base controls the alternating-current source of supply. The direct-current output, indicated by two BX ammeters, is regulated by two dial switch handles on the sides of the base. The two alternating-current leads are on one side of the base, and the three direct-current leads—one of which is positive and the other two negative—are on the other side.

**Installation**—This outfit is provided with two mounting straps for wall mounting. Should this method not be desired, the apparatus may be placed on a bench or any convenient shelf. The leads are so arranged as not to interfere with any method of installation.

**Economy**—The first cost is lower than two of the 6-ampere, 75-volt Rectigons. This type of Rectigon embodies all the simplicity of the smaller size and has an additional feature in the higher charging rate or higher battery capacity.

### STYLES AND CHARACTERISTICS

Style No.	A-C. Volts	Cycles	No. of Cells	D-C. Volts	D-C. Amps.	APPROX. WT., LBS. Net	Boxed	List Price
301860	115	60	3 to 60	7½ to 75	12	90	104	\$220 00
333005	115	50	3 to 60	7½ to 75	12	125	143	240 00
333004	230	50	3 to 60	7½ to 75	12	128	145	240 00
352777	230	60	3 to 60	7½ to 75	12	128	145	220 00

#### RENEWAL BULBS

Rectigon Style No.	Fuse Style No.	Ampere Capacity	Ounces	List Price
301860 } 333003 } 333004 } 352777 }	289416	6	5	\$8 00

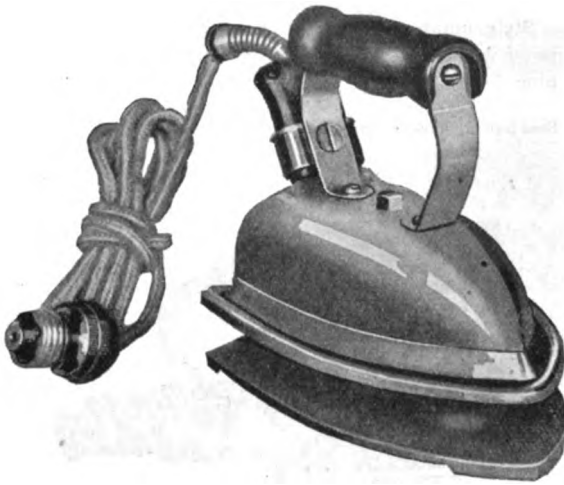
#### RENEWAL FUSES (Two Required)

Rectigon Style No.	Bulb Style No.	Ampere Capacity	Net Weight Ounces	List Price
301860 } 333003 } 333004 } 352777 }	222030	15	....	On Request

*Order by Style Number*

## HOUSEHOLD AND LAUNDRY IRONS

### Six-Pound Westinghouse Iron



Following are some of the special features which earn the description "perfect in design and finish" for the Westinghouse iron:

Weight six pounds; bevelled base which gives greater working surface; sharp point permitting easy ironing of fine work; steel clad heating element; even distribution of heat over the entire face; plenty of room between handle straps for hand; strong terminal cover; firmly welded terminals and perfect contact with plug; comfortable handle; eighty per cent of the entire weight of the iron in the base giving proper balance and great stability; highly polished nickel finish on all exposed metal parts and jet black handle.

**Style number** includes iron complete with fireproof stand, cord with separable attachment plug and receptacle.

**Standard Package**, 6 irons of one style number.  
**Note**—Irons for 32 volts have permanently attached cord and 25-ampere polarized attachment plug.

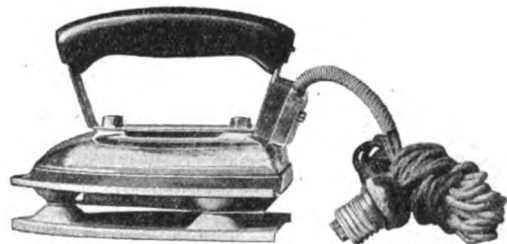
Volts	Watts	Net	WEIGHT,* POUNDS		Standard Package	Style No.
			Boxed Each			
100-110	550	6	7		50	328091
111-120	550	6	7		50	328092
210-230	550	6	7		50	328093
231-250	550	6	7		50	328094
32	550	6	7		50	328095

### Boudoir or Travelers' Iron

The Boudoir Iron, while designed especially for travelers, will be found convenient for all kinds of light pressing in the home. Industrial establishments, such as millinery shops, find it useful.

The base is flanged to give a greater ironing surface and ease in ironing fancy tucks. The cord is permanently attached. A separate fireproof stand is furnished. This stand has an opening between top and middle plates in which a curling iron may be heated.

**Style number** includes the iron with fireproof stand, flexible cord, and attachment plug.



**Note**—Irons for 32 volts have permanently attached cord and 25-ampere polarized attachment plug.

**Standard Package**, 4 irons of one style number.

Volts	Watts	Net	WEIGHT,* POUNDS		Standard Package	Style No.
			Boxed Each			
100-120	250	3	4		20	238887
200-240	250	3	4		20	238888
32	250	3	4		20	284087

\*Net weight includes iron only. Boxed weight includes stand and is approximate.

**Order by Style Number and Specify Exact Voltage**

## HOUSEHOLD AND LAUNDRY IRONS—Continued

**Eight Pound Type E Iron**

This iron is used for heavy pressing in general household work and laundry service where an iron heavier than a six and one-half pound iron is desired.

The heat radiation from the top is prevented by a dead-air space between the heat-storage plate and the iron shell. Practically all heat is retained at the ironing surface. Whatever heat is not being taken by the ironing surface, is stored in the heat-storage plate.

The heating element is wound in a manner that distributes the heat evenly over the ironing surface; therefore there are no hot spots to scorch the clothes.

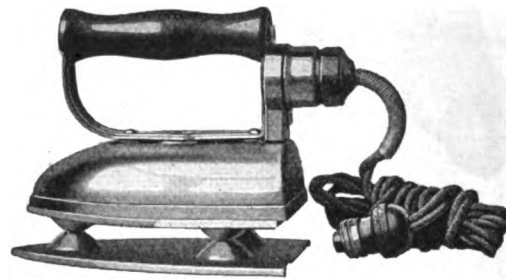
The iron is accurately balanced so as to make handling easy. The handle is correctly shaped to fit the hand and is always cool.

The ironing surface is very smooth. This enables the iron to glide easily over the pieces that are ironed. The ironing surface is quite large and

allows each stroke to do more ironing than can be done with the lighter weight iron.

**Style number** includes iron complete with fire-proof stand, flexible cord and separable attachment plug.

**Standard package, 4 irons of one style number.**



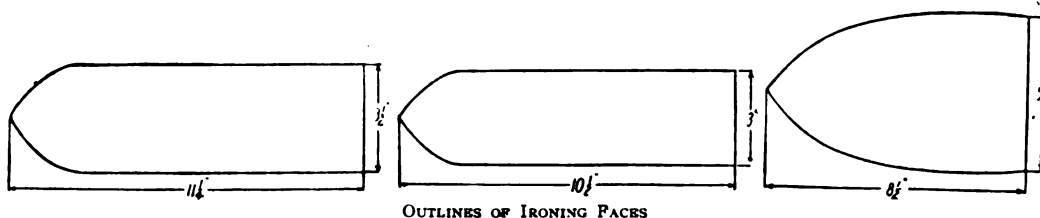
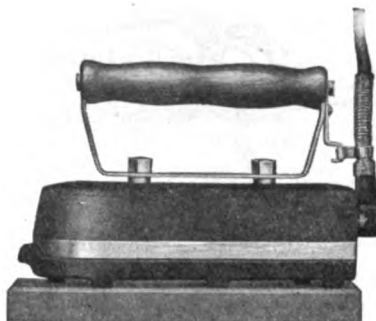
Volts	Watts	WEIGHT*, POUNDS		Style No.
		Net	Boxed Weight	
100-107	635	8	9	230476
108-115	635	8	9	230477
116-125	635	8	9	230478

\*Net weight includes iron only. Boxed weight includes stand.

**Order by Style Number and Specify Exact Voltage**



# TAILOR'S IRONS



Electric irons are specially desirable in tailoring and pressing establishments because of cleanliness, absence of fumes, reduction of fire hazard, saving of time, and the making for quicker and better work.

These irons are similar to standard flat irons but of heavier construction. The stand is a cast-iron plate mounted on a slate base.

**Finish**—Working face, polished; lower edges, blued; casing, dull black; handle standards, bright steel; handle, natural wood color.

**Connections**—Cord is permanently attached. These irons should not be connected to lamp sockets because of their heavy current. A 10-ampere plug switch makes a simple and reliable method of connecting to circuit.

**Style number** includes iron complete with cord and fireproof stand, but no attachment plug.

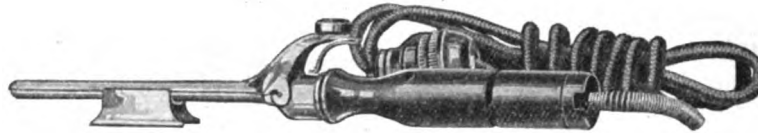
**Unit package**, 1 tailor's iron.

Watts	WEIGHT,* POUNDS		STYLE No.	
	Net	Boxed	100-120 Volts	200-240 Volts
<b>3 Inches Wide, 10 1/2 Inches Long</b>				
700	12	22	122502	122505
750	18	28	122514	122517
<b>3 1/2 Inches Wide, 11 1/4 Inches Long</b>				
800	15	26	121355	121358
800	20	30	121361	121364
850	24	35	121367	121370
<b>5 1/2 Inches Wide, 8 1/2 Inches Long</b>				
750	12	22	122478	122481
750	15	25	122484	122487
800	18	28	122490	122493
750	22	32	122496	122499

\*Net weight includes iron only. Boxed weight includes stand and is only approximate.

**Order by Style Number and Specify Exact Voltage**

## CURLING IRONS



The heating element of the curling iron is in the form of a rod inserted directly in the barrel and can be easily removed for servicing.

The swivel plug which fits in the end of the handle is moulded of specially prepared composition and will not break if dropped. This plug enables the user to grasp the iron in such a way that it can be freely rotated without twisting the cord. Strong spring contacts in the plug assure a good connection.

The cord is attached to these contacts within the swivel plug—there are no exposed terminals.

The detachable clamp fits snugly over the tong and is held down by a dependable spring.

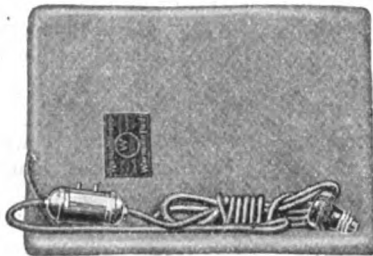
The finish is highly polished nickel, and the handle is ebonized black.

Style number includes curling iron complete with cord and separable attachment plug.

Standard Package, 4 curling irons of one style number.

Watts	APPROX. SHIP. WT., LBS.		STYLE No.	
	Each	Standard Package	32 Volts	100-125 Volts
15	9 oz.	3 lbs.	289373	185143
				200-240 Volts
				289374

## WARMING PADS



Warming pads are soft and pliable; they are encased in fawn-colored felt covers and can be applied to any part of the body with comfort, being so light that their weight is unnoticed.

**Heat Control** The 95-125 volt and 32-volt pads in the 12"x15" size have a three heat switch on the cord. All others are single heat and are turned off or on at the socket.

**Automatic thermostats** are mounted inside the pads to prevent overheating. These thermostats

automatically cut off the current before the temperature has become excessive and automatically close the circuit when the pad has cooled to normal temperature.

Style number includes warming pad, flexible cord and separable attachment plug, and, on the larger size pad only, a three-heat switch. The smaller size pad is single-heat.

Standard Package, 4 warming pads of one style number.

Size Inches	Volts	Watts	APPROX. SHIP. WT., LBS.		Style No.
			Each	Standard Package	
9x12	95-125	48	2	10	258418
12x15	95-125	65	3	15	258417
12x15	200-240	65	3	15	283921
9x12	32	48	2	10	283923
12x15	32	65	3	15	283922

Order by Style Number and Specify Exact Voltage

## COFFEE PERCOLATORS AND URNS

### PERCOLATOR CREAM-AND-SUGAR SETS



9-CUP COFFEE URN COMPLETE WITH CREAM-AND-SUGAR SET

Every coffee lover knows that a percolator makes the best coffee. With an electric percolator, coffee may be made at the table and the heat turned on and off at just the right time. Not only is there no danger or bother as with an alcohol percolator, but the electric percolator is cheaper to use and much more convenient. Simply insert the plug and within a very short period of time, the coffee starts to perk.

Two complete percolator sets with a cream pitcher, sugar bowl and serving tray form a most attractive, as well as serviceable addition to the line of Westinghouse percolators. Every piece in these sets harmonizes perfectly with every other piece. Each set is unusually pleasing in appearance, practical and convenient. A set makes an ideal present.

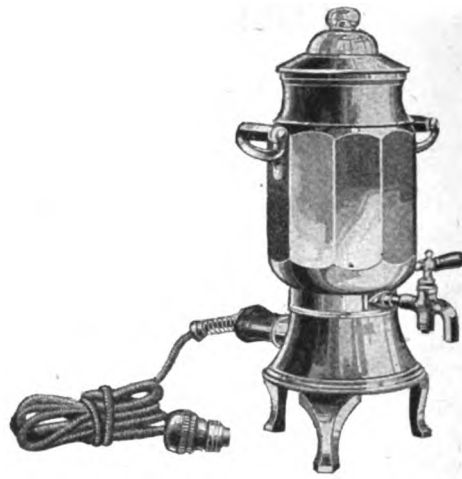


8-CUP COFFEE URN COMPLETE WITH CREAM-AND-SUGAR SET

## COFFEE PERCOLATORS AND URNS—Continued



9-CUP COFFEE URN



8-CUP COFFEE URN

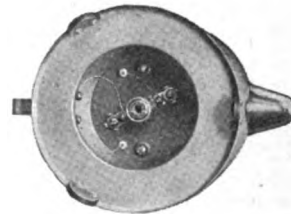
The assortment of percolators shown herein should meet the demands of the most critical. The sizes from six to nine cups in the plain percolators and urns, of the loving cup and panel types will, it is felt, make the line of percolators quite complete. The cream pitcher, sugar bowl and tray are neatly finished and are designed to harmonize with the percolators.

**Special Features**—These percolators begin to operate promptly. Coffee is finished in 10 to 20 minutes, depending on strength desired. The heat is concentrated so that only a small quantity of water needs to be heated at a time. Coffee basket can be removed and the vessel used to boil water.

**Construction**—All percolators listed have a vessel made of spun sheet metal. The pot-type has a sheet spout and black ebonized handle; the urn and loving-cup styles have a neat metal spigot and are equipped with black ebonized handles. The top, made of specially heat-treated glass, is easily removed from the lid. The coffee basket is made of aluminum and the valve of nickel-silver.

**Fuse**—The percolator should never be operated when the heater is not completely covered by

liquid. To guard against possible burnouts due to the percolator accidentally becoming dry, all Westinghouse percolators are equipped with fusible metal plug cutouts, which will melt and disconnect the circuit when the temperature of the heater approaches the danger point. It can be renewed by simply removing the base of the percolator, unscrewing the old plug with the aid of a screw driver or a small coin and inserting a new plug in its place.



INVERTED VIEW SHOWING FUSIBLE METAL PLUG CUTOUT

**Style number** includes percolator complete with flexible cord, separable attachment plug and receptacle.

**Standard Package**, 4 percolators.

COFFEE PERCOLATORS AND URNS—Continued



6-CUP COFFEE PERCOLATOR



7-CUP COFFEE PERCOLATOR

Percolators

Description	Watts	Each	APPROX. SHIP. WT., LBS. Standard Package	STYLE NUMBERS				
				32 Volts	100-110 Volts	111-120 Volts	210-230 Volts	231-250 Volts
6-Cup Percolator Plain Type	420	6	35	284057	284252	284253	284254	284255
7-Cup Percolator Panel Type	420	6	35	.....	284248	284249	284250	284251
8-Cup Urn Panel Type	420	6	35	284058	284244	284245	284246	284247
9-Cup Urn Loving-Cup Type	420	6	35	299559	284256	284257	284258	284259

Cream Pitcher

Sugar Bowl

Tray

Panel Design  
Plain Design

327483  
327481

327484  
327482

} 327485

Order by Style Number and Specify Exact Voltage

## CHAFING DISHES



The type C chafing dish uses as a heater a standard six-inch disc stove with the feet inserted in reversed position.

For frying and stewing or any cooking that requires a high temperature, the water pan may be omitted and the food pan placed directly upon the stove.

The disc stove may be used separately if desired. It will do any light cooking and heating that a single-burner gas stove will do.

**Finish**—Type C vessels are finished in highly polished nickel.

**Style number** includes water pan, food pan, cover, stand, disc stove with flexible cord and separable plug; also indicating push switch with three-heat stoves. Single-heat stoves do not have switch.

**Standard Package**, 1 chafing dish.

Volts	Watts	Heats	Finish	APPROX. SHIP. WT., LBS. Each	Style No.
100-120	150-300-600	3	Nickel	12	300296
200-240	600	1	Nickel	12	300297

## ROUND TRAYS

A 12-inch tray finished to match the vessel, while not necessary in the operation of cooking, adds greatly to the appearance of the outfit and protects

the furniture from any food which may be accidentally spilled. This tray is not included with the chafing dish but is listed separately.

**Finish**  
Nickel

**Style No.**  
151466

## TURNOVER TOASTERS

The "turnover" feature consists of a swinging rack on either side which is hinged at the bottom. It is unnecessary to touch the bread from the time it is first put on the rack until it is taken off toasted. The rack is lowered and raised by means of ebonized knobs. This simple operation turns the toast.

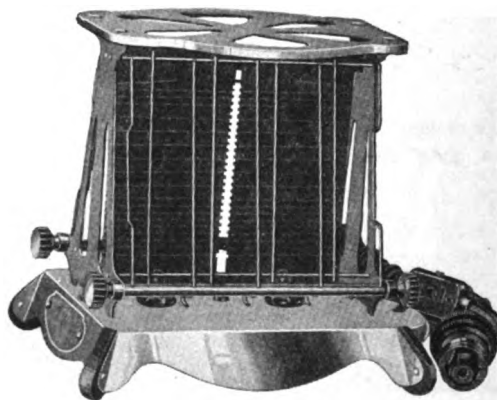
**Construction**—The toaster is substantially built and is finished in highly polished nickel.

A flat surface on top of the toaster may be used to keep the toast warm or it may be used to heat plates, keep the coffee warm, etc.

**Style number** includes toaster and flexible cord with permanently attached plug and through switch.

**Note.**—Through switch omitted on 32-volt devices, equipped with 25-ampere polarized wall plug.

**Standard Package**, 6 turnover toasters.



Watts	APPROX. SHIP. WT., LBS. Each	STANDARD PACKAGE	STYLE NO.
500	3½	25	32 Volts 283983
			100-120 Volts 284032
			200-240 Volts 284033

**Order by Style Number and Specify Exact Voltage**

## WATER HEATERS



Volts  
100-125

Watts  
500

APPROX. SHIP.  
WT., LBS.  
Each  
4

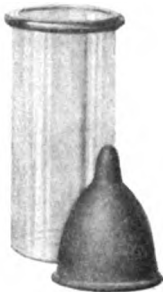
Style No.  
170996

The Water Heater holds one pint and will boil this quantity of water in six minutes. Excellent for heating water for shaving, and will be found exceedingly useful around the home or laboratory. The vessel is formed of heavy sheet copper, tinned on the inside. A clip on the handle of heater engages with projection on vessel, thus permits the vessel to be carried by the handle when heated. Vessel has lip for convenient pouring.

**Style number** includes vessel, heater, cover and flexible cord with separable attachment plug.

**Standard Package**, 1 water heater.

### Accessories for Water Heaters



SANITARY MILK BOTTLE AND NIPPLE

**Accessories**—A Standard Hygeia milk bottle can be supplied to fit the pint water heater and makes an excellent addition to the nursery equipment.

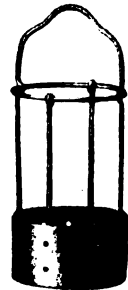
The sterilizer basket makes a complete and practical instrument sterilizer.

**Standard Package**, 1 bottle with nipple or basket.

Approx.  
Ship. Wt.,  
Lbs., Each  
1  
¼

Description  
Milk Bottle and Nipple  
Sterilizer Basket

Style No.  
146284  
162123



STERILIZER BASKET

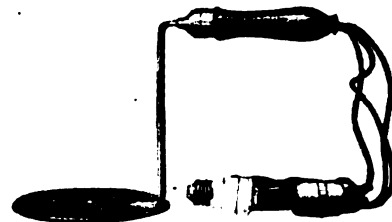
## DISC IMMERSION HEATERS

**Disc Immersion Heater** may be used to heat liquids in almost any vessel, the capacity of which is within the range of the heater and the temperature of which does not exceed 250 degrees Fahrenheit. It is easily portable and very efficient. **The heater should always be completely immersed.** The heating element is sealed in the disc, insuring long life and offers a large heating surface. Adaptable for the home and also for industrial purposes where the heating of water or other liquids is desired.

**Style number** includes heater complete with flexible cord and control switch. The five and six-inch heaters have a two-heat control switch and separable

attachment plugs. The eight-inch heater is supplied with a three-heat snap switch for wall mounting but no attachment plug.

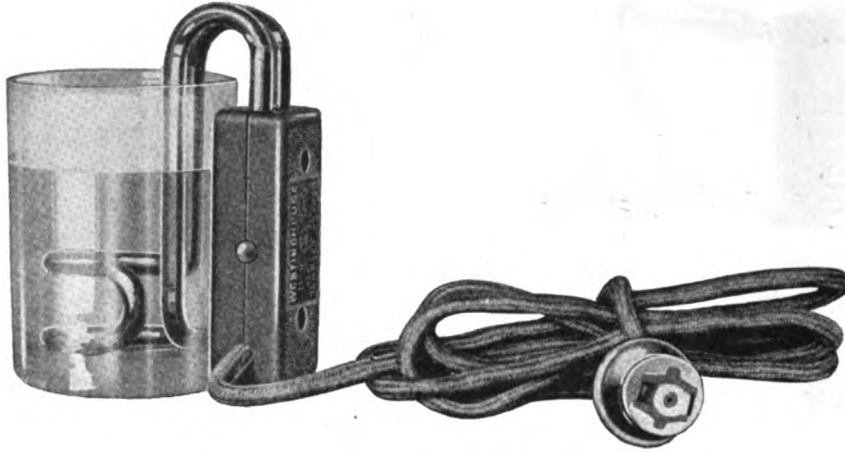
**Standard Package**, 1 disc immersion heater.



Diameter Inches	WATTS INPUT			APPROX. WT., LBS.		Style No. 100-120 Volts
	Maximum	Medium	Minimum	Net	Shipping	
5	500	...	125	3	4	151102
6	650	...	162	5½	6½	151104
8	1100	550	275	9	10	151106

**Order by Style Number and Specify Exact Voltage**

## TUMBLER WATER HEATERS



TUMBLER HEATER IN GLASS OF WATER

The tumbler water heater is designed to heat a small quantity of water quickly and efficiently. It is a complete water heater of convenient size, and is so substantially and durably constructed that it is practical for heating any small quantity of liquid.

**Distinctive Features**—When the tumbler heater is placed in a glass of water, it rests on the base of the switch thus preventing the weight of the heater from tipping the glass. The switch also affords a rest for the heater when it has been removed from the liquid. By laying the tumbler water heater

so that the tubing extends in the air, it is impossible for the table upon which the heater is lying to be scorched.

**Construction**—The element is inserted in copper tubing bent to afford a large heating surface. It is nickel plated and highly polished. The through-switch of black composition is extra large to provide a convenient rest as well as a practical switch for the heater.

**Style number** includes heater complete with through-switch, cord and plug.

<b>Voltage</b>	<b>Wattage</b>	<b>APPROXIMATE WEIGHT</b>		<b>Standard</b>	<b>Style</b>
110-120	350	<b>Net</b>	<b>Shipping</b>	<b>Package</b>	<b>No.</b>
		1 lb.	1½ lbs.	4	310975

*Order by Style Number and Specify Exact Voltage*



## COZY-GLOW RADIATORS



The Cozy-Glow Radiator is built for stability, utility and efficiency. A heavy cast-iron base insures solidity, yet allows the radiator to be easily moved from place to place. The heating unit is easily removable, and consists of a porcelain cylinder around which the heating element is wound. It is protected by a stout copper-wire guard, which can be removed for cleaning the reflector. The reflector, which directs the heat rays, is built of polished copper, neatly finished and heavily lacquered to prevent tarnishing.

**Applications**—A most convenient heater for warming the bed room, bath, or nursery on chilly mornings and evenings during the early spring, fall and winter. Especially good for ticket booths, watchmen's boxes and waiting rooms and for preventing the frosting of show windows.

A feature of the radiator is the concentrated heat beam and the pleasing, soft, mellow glow it produces when in operation.

The design allows the control of the direction of the heat rays.

**Style number** includes radiator complete with a 10-foot flexible cord and separable attachment plug.

**Standard Package**, 3 Cozy-Glows of one style number.

Volts	Watts	APPROX. SHIP.		Style No.
		Each	Wt., Lbs.	
100-120	600	11	Std. Pkg. 40	278758
200-240	550	11	40	278759

## AUTOMOBILE ENGINE HEATERS

**Construction**—The Westinghouse automobile-engine heater is substantially built and practically indestructible. The heating unit is protected by a strong perforated sheet-metal guard entirely surrounding the heater. A rigid metal hook allows the heater to be hung anywhere under the automobile hood. The flexible cord is long and the plug can be attached to any lamp socket. Altogether it is a well-built heater with no delicate parts to get out of order.

**Efficient**—The heater can be placed where it will do the most good. Instead of heating the garage, the heat is delivered only where it is needed—near the engine and carburetor, but is not guaranteed to prevent freezing under extreme conditions.

**Economical**—The Westinghouse automobile-engine heater consumes only 200 watts. The cost of operating the engine heater is extremely small.

**Style number** includes heater complete with flexible cord and separable attachment plug.

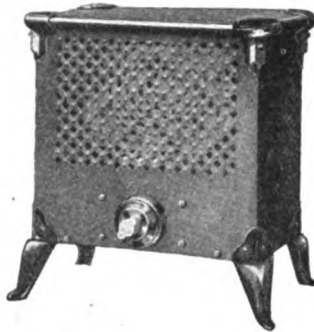
**Standard Package**, 4 engine heaters.



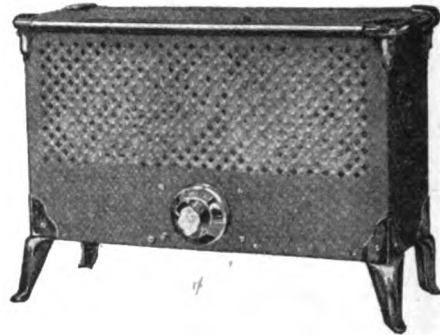
Volts	Watts	Height Inches	Diameter Inches	APPROX. SHIP.		Style No.
				Each	Wt., Lbs. Standard Package	
100-120	200	8 1/2	3	1 1/2	30	283395
200-240	200	8 1/2	3	1 1/2	30	284238

Order by Style Number and Specify Exact Voltage

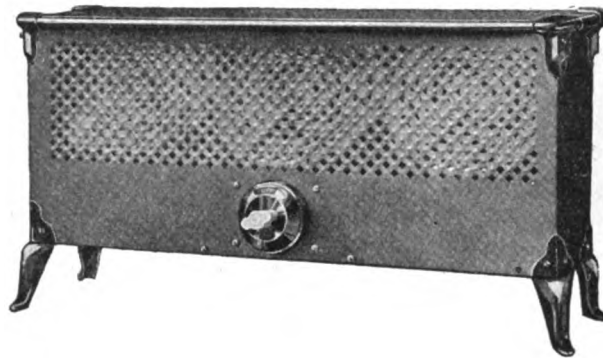
**TYPE D AIR HEATERS**



1000-WATT SIZE



2000-WATT SIZE



3000-WATT SIZE

**Electric Air Heaters** are adapted for the heating of residences or buildings. They are particularly useful in the heating of isolated rooms or small buildings which can not conveniently or safely be heated by other methods. These heaters afford the most ideal way for heating a building or residence throughout the winter. Where the cost of power makes their continuous use prohibitive, they may be economically applied for heating during the chilly days of fall and spring when only a small amount of heat is required, without the moisture produced by a gas fire or the soot and dirt of a coal fire.

**Special Features**—Heating element is fully protected from electrical and mechanical injury. It heats by circulation of air and radiation. Has substantial terminals and heavy copper connections.

Finished in black Japan with highly polished nickel trimmings, no heavy castings—lightest construction possible.

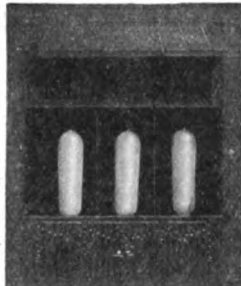
**Style number** includes heater complete with a three-heat snap switch, but no attachment plug. A wall receptacle of ample size should be used.

**Standard Package, 1 air heater.**

High	WATTS		APPROX. DIMENSIONS			APPROX. WEIGHT		STYLE NUMBER	
	Medium	Low	Length	Width	Height	Net	Boxed	100 to 120 Volts	200 to 240 Volts
1000	500	250	11 <sup>3</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>4</sub>	13 <sup>3</sup> / <sub>4</sub>	9	15	280532	280533
2000	1000	500	18 <sup>3</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>4</sub>	14	12	22	280534	280535
3000	1500	750	26 <sup>1</sup> / <sub>4</sub>	7 <sup>1</sup> / <sub>4</sub>	15	16	27	280536	280537

**Order by Style Number and Specify Exact Voltage**

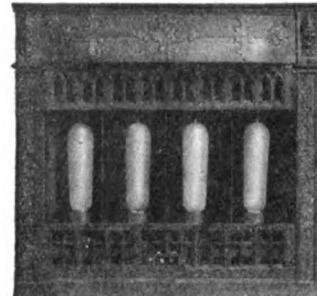
## MANTEL OR FLUSH-TYPE LUMINOUS RADIATORS



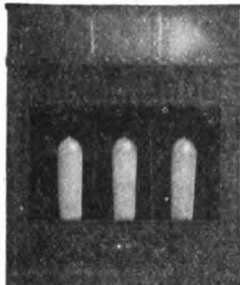
STYLE NOS. 218049 AND 218050



STYLE No. 218042



STYLE NOS. 218051 AND 218052



STYLE NOS. 218047 AND 218048



STYLE No. 218119



STYLE No. 218046

Style number includes radiator frame with single-heat flush push-button switch (except on style number 218119), but without heating units or portable cord. In some cases, the switch is mounted directly

in the radiator front. Order luminous heating units as a separate item, specifying style number and quantity desired. The frames are furnished in polished brass, oxidized copper, and antique brass.

Standard Package, 1 radiator.

### Mantel-Type Frames

DIMENSIONS IN INCHES						
Volts	Radiator	Wall Opening Required	Tiles	Units	Style No.	
100-125	24x26	.....	.....	3	218042	
100-125	24x30	21x28x5	16	3	218046	
100-125	30x30	26x28x5	17	4	218047	
100-125	24x30	23x28x5	16	3	218048	
100-125	30x30	28x28x5	17	4	218049	
100-125	24x30	23x28x5	16	3	218050	
200-250	30x30	28x28x5	17	4	218051	
100-125					218052	
200-250	24x30	23x28x5	16	3	218052	

### Bathroom-Type Frames

100-125	Polished Nickel	15 1/2 x 18	12x16x4	..	2	218119
200-250						

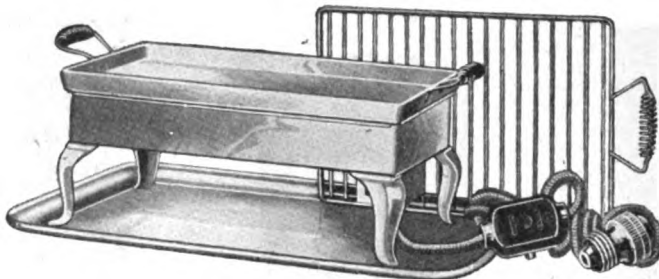
### Luminous Units

Standard Package, 3 luminous units of one style number.

Watts	Approximate Shipping Weight, Pounds	STYLE No.			
		100-110 Volts	111-125 Volts	200-225 Volts	226-250 Volts
250	4	102746	102747	222108	222109
500	4	222110	222111	222112	222113

Order by Style Number and Specify Exact Voltage

## TABLE STOVES



The **Table Stove** is not merely a toaster but a complete and practical stove that will cook anything that can be cooked in the ordinary frying pan or on a turnover toaster. This wide range of usefulness makes it the most popular electric cooking device on the market. The frame and legs are heavily nickel plated and highly polished.

The griddle is made of heavy gauge sheet aluminum and is equipped with a coiled wire handle on each end.

The wire toasting screen is finished in dull nickel.

The flexible cord is permanently connected to heavy brass terminals inside the stove.

The tray is beautifully finished in nickel.

**Style number** includes table-stove, toasting rack, aluminum griddle and frying plate, tray and flexible cord with through switch and separable attachment plug.

**Note**—Through switch omitted on 32-volt devices, equipped with 25-ampere polarized wall plug.

**Dimensions**, 9 inches by 5¼ inches by 3¾ inches high.  
**Standard Package**, 4 table-stoves of one style number.

Volts	Watts	APPROX. SHIP. WT., LBS.		Style No.
		Each	Standard Package	
100-120	500	7	25	196168
200-240	500	7	25	214903
32	500	7	25	284080

## DISC STOVES



**Applications**—Useful for a great variety of purposes in the home and laboratory. The house-keeper uses it for light cooking of all kinds, for making tea, heating water, etc. The dentist finds it convenient for gold annealing, packing plates and making bridges. It provides the ideal form of heat for the chemical laboratory.

**Features**—Heater supported on a metal stand.

Cord permanently attached with push-button through switch for heat control on single heat disc stove. The three-heat disc stove is controlled by a three-heat indicating snap switch.

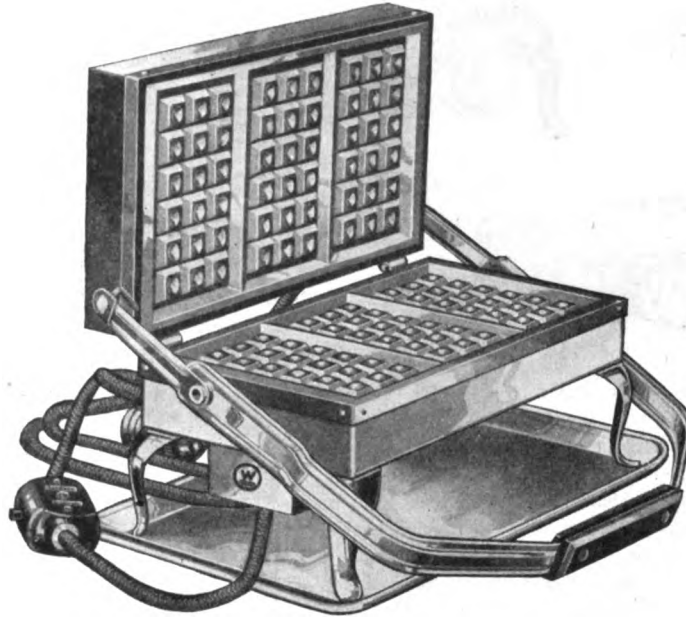
**Style number** includes stove complete with flexible cord and separable attachment plug; also indicating push switch with three-heat stoves.

**Standard Package**, 4 assorted stoves.

Heats	Finish	Watts	APPROX. SHIP. WT., LBS.		Volts	Style No.
			Each	Standard Package		
1	Nickel	600	4½	24	100-120	189204
3	Nickel	150-300-600	5	28	100-120	189198
1	Nickel	600	4½	24	200-240	270701

Order by Style Number and Specify Exact Voltage

# WAFFLE IRONS



The Westinghouse Waffle Iron is an unusual addition to our line of Electric Ware. It will make an attractive appointment for the dining room and an especially useful gift.

The construction is strong, assuring long and satisfactory service. The griddles are cast aluminum and permit the baking of three crisp delicious waffles at one time. No grease is required on the griddles. A handsome tray makes the apparatus complete.

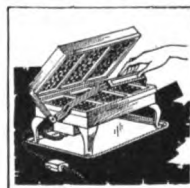
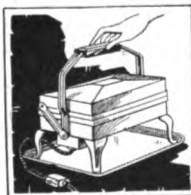
A special feature is the handle which raises and lowers the top griddle and also permits easy carrying. The cord is permanently attached.

A beautifully illustrated recipe book showing how to make three dozen delicious dishes is packed with each waffle iron.

The style number includes waffle iron, tray, flexible cord and through switch.

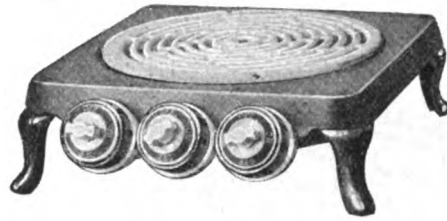
Standard Package, 1 waffle iron.

Volts	Watts	APPROX. WEIGHT, LBS.		Style No.
		Net	Boxed	
100-110	600	8	10½	284284
111-120	600	8	10½	284186
200-220	600	8	10½	284285
221-240	600	8	10½	284187



Order by Style Number and Specify Exact Voltage

## HOT PLATES



TYPE 21 HOT PLATE



TYPE 31 HOT PLATE



TYPE 32 HOT PLATE

These hot plates are small electric stoves for hotel, restaurant, cafe and domestic service. No special flat-bottomed utensils needed. The radiant heaters with all the heat at the top are very efficient with ordinary cooking vessels. Noncorrosive material used for the heating elements; water or food spilled over the heater will not damage it. Deflector plates below the heaters prevent scorching the table.

The type 21 has a ten-inch heater mounted in black japanned cast steel frame and controlled by

three separate switches. These heat an area of 6, 8 or 10 inches in diameter, making three plates in one.

Type 31 has eight-inch heater mounted in black japanned cast steel frame and controlled with a three-heat switch.

Type 32 has eight-inch heater mounted and equipped with through switch.

Standard Package, 1 hot plate.

Volts	Type	Heaters	Heats	Watts	Approx. Ship. Wt., Lbs.	Style No.
110-120 } 200-240 }	21	One 10-inch	3	2000 Max.	20	288972
				1334 Med.		288974
				667 Low.		
100-120 } 200-240 }	31	One 8-inch	3	1000 Max.	15	231582
				500 Med.		231584
				250 Low.		
100-110 } 111-120 } 210-230 } 231-250 }	32	One 8-inch	1	660	10	231588
						231587
						231588
						231589

## COFFEE URN HEATER



The coffee urn heater is designed for hotel, restaurant and cafeteria use or wherever large coffee urns are employed. These heaters are made in two sizes, eight and ten-inch. The eight-inch is designed for use with 5 and 6-gallon coffee urns, while the large or ten-inch is applicable to the 10-gallon coffee urns. Both sizes are equipped with three-heat indicating snap switches and are mounted on a black japanned steel adjustable base which is used in lowering or raising the heater. The heater can be raised from its original height of 7½ inches to 12 inches.

Style number includes heaters complete with three-heat switch.

Standard Package, 1 coffee urn heater.

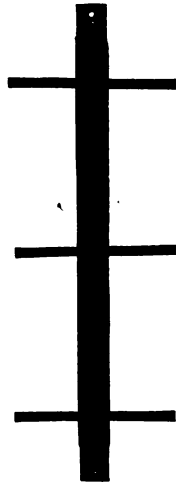
Heaters	Heats	Watts	Volts	Approx. Ship. Wt., Lbs.	Style No.
10-inch	3	3000	100-120	20	288978
10-inch	3	3000	200-240	20	288977
8-inch	3	2000	110-120	15	288978
8-inch	3	2000	200-240	15	288979

Order by Style Number and Specify Exact Voltage

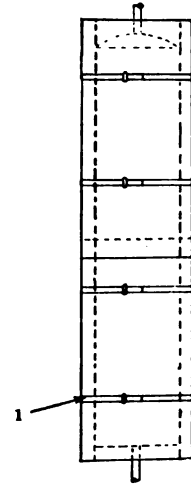
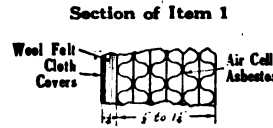
## STRAP-ON HEATERS



APPLICATION PHOTOGRAPH SHOWING INSTALLATION



SINGLE SPACE HEATER WITH BANDS



WORKING DIAGRAM OF ONE GOOD TYPE OF INSULATION

The strap-on heater is primarily a space heater application adapted to the heating of tanks where the temperature required does not exceed 300 degrees Fahrenheit. Although any metal tank can be heated by this method, the principal demand will undoubtedly be found in homes and small shops for hot water heating equipment. The construction is very simple, two or more space heaters being fastened against the lower half of the tank by means of three steel bands with clamps. The bands are adjustable and very simple in construction. Their purpose is to hold the heaters firmly against the surface of the tank and prevent loss of heat.

All wire connections are made with asbestos covered wire. Over this should be placed a heavy heat insulation which is also held on with metal bands.

The principal features which recommend this method of hot water heating are: simplicity of construction, ease of application, ease of removal for repair or installation in other locations. Large surface heated at one time raises temperature of water quickly, but without the intense heat at point of application which is so apt to cause a lime deposit in hard water.

The automatic temperature control consisting of thermostat and motor operated switch is an excellent addition to this equipment. The thermostat is inserted through the heat insulation and has been found very efficient.

**Style number** includes the strap-on heater complete with necessary wiring and three steel bands for securing the heaters to boiler.

Volts	Wattage	Number and Length	APPROXIMATE WEIGHT, LBS.		Style No.
			Net	Shipping	
100 } 120	1000	2-24 in.	3	5	310774
100 } 120	2000	4-24 in.	6	8	310729
100 } 120	3000	6-24 in.	8½	11	310730

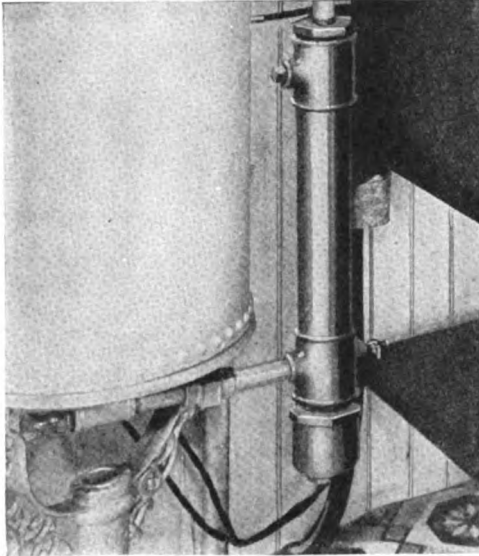
NOTE: The heat insulating material is essential to the efficient operation of the strap on heaters. Although Westinghouse does not handle this material, a careful study of the subject has been made. A number of the leading manufacturers of insulating material have sent us their recommendations and samples, and all of these have been thoroughly tested.

The names of these manufacturers together with the latest information, including specifications, prices and terms will be sent immediately upon application.

**Order by Number and Specify Exact Voltage**

## BAYONET IMMERSION HEATERS

Circulation water heaters or immersion heaters are used with an insulated storage tank to supply hot water for household use; in coffee urns; and for all applications where heating may be accomplished directly or indirectly by heating of a liquid the temperature of which should not exceed 250 degrees Fahr.; or a liquid pressure of 150 pounds per square inch.



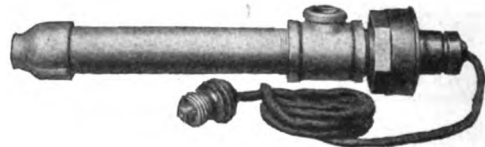
- Type "C"—400-600 Watt, equipped with cord and plug only.
- Type "C"—1000-2000 Watt, equipped with three heat snap switch.
- Type "B"—2500-3500 Watt, equipped with three heat snap switch.
- Type "B"—4500-6000 Watt, 220 volts, equipped with three heat snap switch.
- Type "B"—4500-6000 Watt, 110 volts, equipped with knife switch.
- Type "B"—4500-6000 Watt, 250 volts, equipped with three heat snap switch.

The heaters may be removed from the casing and inserted directly in the vessel containing the liquid; completely immersing the blades.

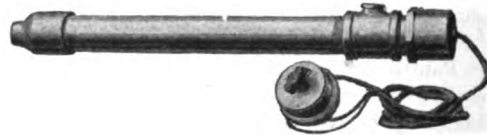
**Lagging** — For most efficient operation, the tanks, heater casings, and all connection pipes should be well lagged to prevent heat loss by radiation.

**Features** — Simple construction makes these heaters easily removable and hence, readily cleaned. Being completely immersed in the liquid, they are extremely efficient. They are strong and durable and will withstand a reasonable amount of abuse.

**Construction** — The types "B" and "C" heaters differ only in size, number of blades and the construction of the terminals. They consist, essentially, of a flat ribbon resistor, assembled in a mica

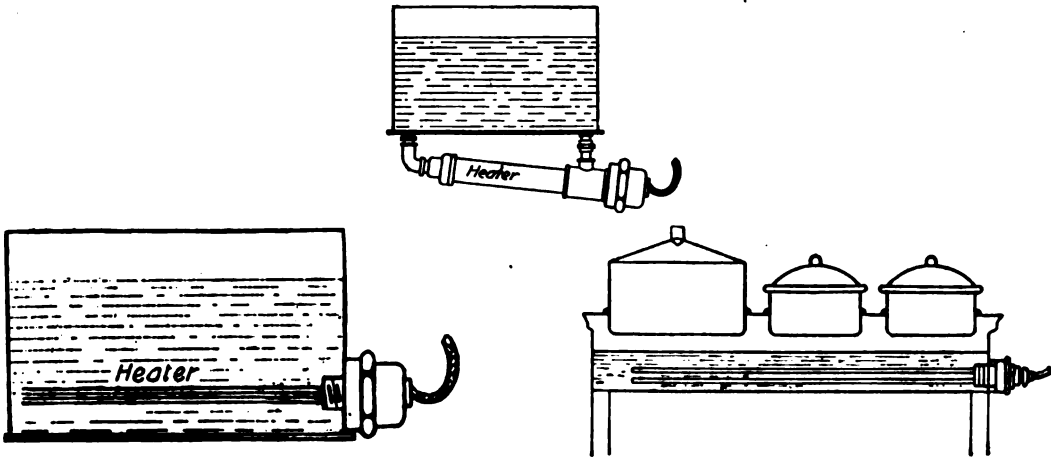


TYPE C BAYONET HEATER



TYPE B BAYONET HEATER

sheath and encased under pressure into a brass head. The brass head is threaded to screw into the casing. The casing consists of a piece of standard iron pipe with proper fittings to attach to the water system.





BAYONET IMMERSION HEATERS—Continued

RATINGS

Max.	Med.	Low	Approx. Shipping Wt., Lbs.	Style No. 100-120V.	Style No. 200-220V.	Style No. 240-260V.
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TYPE C

Without Switch or Casing

400	...	...	14	239068	239070	.....
600	...	...	16	239076	239078	.....
1000	500	250	20	239084	239086	.....
2000	1000	500	22	239092	239094	.....

- 251255 Casing for 2000W 110V and 220V also for 1000W 220V
- 239097 Casing for 1000W 110V also for 400W 220V
- 239095 Casing for 600W 110V also for 400W 110V
- 239096 Casing for 600W 220V
- 144865 Switch for 2000W 220V 1000W both voltages
- 180451 Switch for 2000W 110V
- 239121 Cord for 2000W 220V 1000W both voltages
- 239122 Cord for 2000W 110V
- 215553 Cord for 400W 600W both voltages

Max.	Med.	Low	Approx. Shipping Wt., Lbs.	Style No. 100-120V.	Style No. 200-220V.	Style No. 240-260V.
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TYPE B

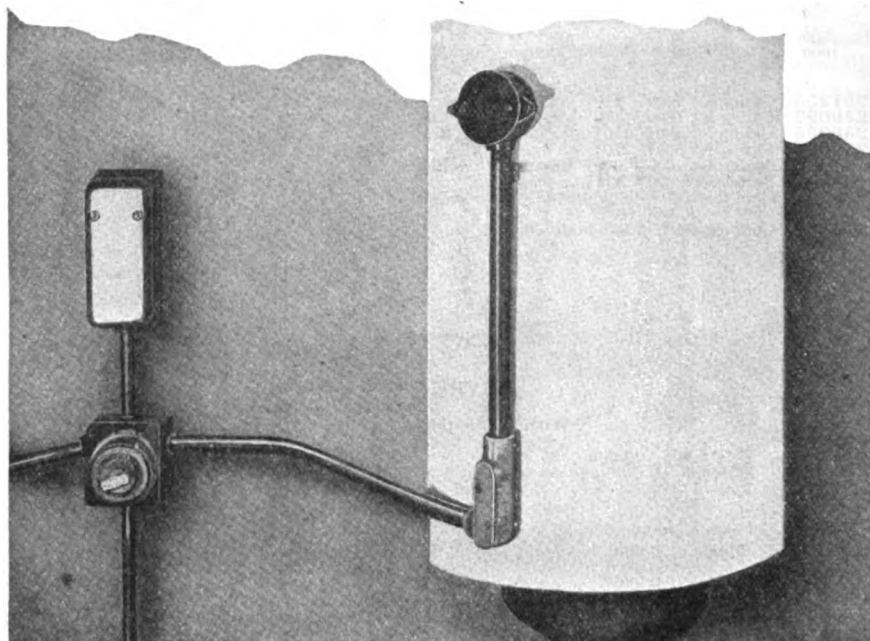
Without Switch or Casing

2500	1250	625	28	280952	280953	285360
3500	1750	875	30	280954	280955	285361
4500	2250	1125	..	280956	280957	285362
6000	3000	1500	..	280958	280959	285363

- 282303 Casing for all 2500W heaters
- 282304 Casing for all 3500W heaters
- 282305 Casing for all 4500W heaters
- 282306 Casing for all 6000W heaters
- 180452 Switch for all 2500W, 3500W, 220V 4500W and 220V 6000W heaters
- 159908 Knife switch for 110V 4500W and 110V 6000W heaters
- 241281 Cord for all 2500W 220V 3500W 220V 4500W 220V 6000W heaters
- 241282 Cord for 110V 3500W 110V 4500W 110V 6000W heaters

Order by Style Number and Specify Exact Voltage

## AUTOMATIC TEMPERATURE CONTROL FOR Electric Water Heaters



AUTOMATIC TEMPERATURE CONTROL APPLIED TO WATER HEATER ON BOILER

The automatic temperature control is primarily designed and intended for regulating the flow of electricity into an electric water heater so as to maintain the water at a predetermined temperature. This completes our water heating system very effectively. It brings conservation of current to what is already conceded to be the most efficient method of heating water by electricity. It combines with this economy a perfect regulation of the temperature to suit the purposes for which the water is to be used. Whereas the most common application of the control is in connection with the bayonet type and strap on water heaters in domestic uses, it can also be used to control temperatures of any equipment where the thermostat can be placed in contact and its application comes within the capacity of the motor operated switch which is as follows:

30 amperes a-c. or d-c. at 110 volts.

20 amperes a-c. at 220 volts.

15 amperes d-c. at 220 volts.

The automatic temperature control equipment consists of a motor operated switch and thermo-

static regulator, mounted in separate cases. The thermostat consists of a coil of bimetallic strip which when expanded or contracted by a change in temperature actuates a contractor tongue adapted to move between two stationary contacts. These stationary contacts are magnetized so as to make a firm contact with the tongue when it is brought in touch by the action of the coil. A hand which is movable over a graduated dial serves to adjust the temperature at which the thermostat operates. The bimetallic strip and its supporting parts are mounted in a cast case with a cover held on by a small screw. The bottom of the case is left open so that when it is mounted against the boiler the bimetal will be freely exposed to the boiler temperature. The thermostat must be mounted in contact with the boiler, and if the boiler is heat-insulated with boiler cover, as it should be, a hole must be cut through the covering for the thermostat.

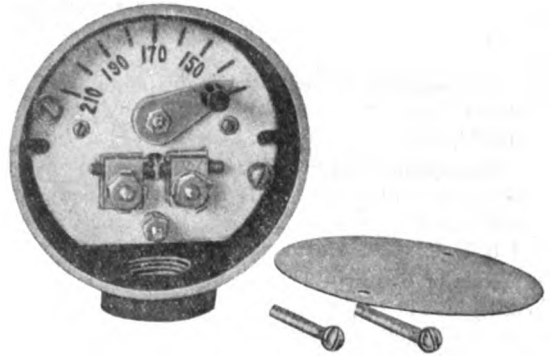
The switch consists of a standard heavy capacity snap switch with a small motor geared to it for operating. This switch breaks only one side of

**AUTOMATIC TEMPERATURE CONTROL—Continued**

the circuit, but has contacts so arranged that the small motor is fed through the switch, and current cut off from the motor after each operation by these contacts. This arrangement is such as to



SHOWING THERMOSTAT AND SWITCH CONTROL



THE TEMPERATURE CONTROL WITH COVER REMOVED

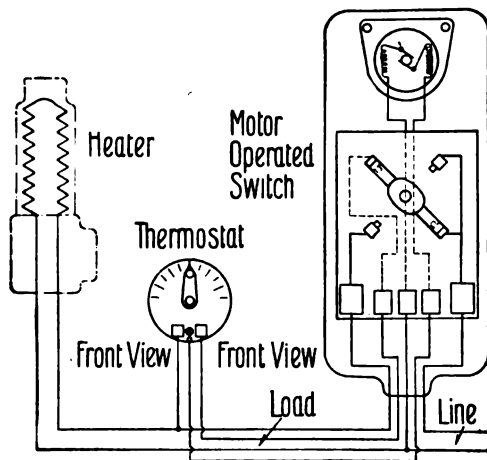
It will be seen that one of the outstanding features of this instrument is simplicity, first in construction, second, in installation, third in operation. It is unailing in performance and considering its purpose is extremely accurate. The lag factor is very small when properly installed.

get successive "On and Off" operation by contacts alternately between a lead to the motor and one or the other of two control wires of the thermostat. This contact is made by the movements of the thermostat contactor tongue under the influence of the heat sensitive bimetalic strip.

**AUTOMATIC TEMPERATURE CONTROL**

(Consisting of Thermostat and Motor Operated Switch)

Volts	Maximum Capacity	Approx. Shipping Weight, Lbs.	Style No.
110	30 Amps. a-c. or d-c.	12	311726
220	20 Amps. a-c., 15 Amps. d-c.	12	315357



WIRING DIAGRAM

Order by Style Number

## WATER HEATING

The **capacity of heaters** for any application is determined by (1) weight of water, (2) rate of heating, (3) radiation and other losses.

**Absorption of Heat by Water**—The specific heat of water is 1.00. One B. T. U. or .293 Watthours will heat 1 lb. of water 1 degree Fahrenheit, hence 1 B. T. U. = .293 Watthours.

**Rate of Heating**—The input for heating of water only must be sufficient to deliver the total quantity of heat required in the time desired. This equals the total watthours required divided by the number of fraction of hours allowable for doing the heating.

**Losses—**

Character of Surface of Tank	Watts Lost per Degree F. per Sq. Ft.	Watts Lost per 30-Gal. Tank per Degree F.
Rough Iron.....	.80	13.8
Polished Copper or Nickel.....	.58	10.0
Rough Iron Poorly Lagged.....	.50 Approx.	8.6
Rough Iron well Lagged 2 Inches Thick.....	.20 Approx.	3.5

(A thirty-gallon tank has approximately 17.2 square feet of exterior surface.)

The maximum input of the heater must, therefore, be sufficient to heat up the water in the time required and supply the radiation losses.

General information is often required as to the temperatures of water for various purposes. The following data pertaining to this must necessarily vary somewhat with different individuals, but will serve as a guide in determining the amount of heat to allow for heating the water for such purposes.

	Temperature Degrees F.
Bath.....	95
Hands, average.....	104
Hands, maximum.....	113
Face.....	99
Luke Warm.....	86
Temperature of water in boiler.....	160

A temperature drop of 5 or 10 degrees may be obtained in a relatively short length of pipe. In order to reduce the loss to a minimum, hot water pipes should be lagged to retain the heat. This makes it unnecessary to drain off a large quantity of water before water of sufficient warmth reaches the user. To the amount of hot water at boiler temperature used, there will be added at least an equal amount of cold water. Consequently, in determining the quantity of water required for a given purpose, it must be borne in mind that the quantity of water actually heated may be considerably less than the total amount required for use, since it is heated initially to a much higher temperature than that actually required in order to get a great quantity of heat stored in a relatively small space.

For the determination of the amount of power required for heating a given quantity of water, the following information is required:

1. Capacity of tank or pounds of water to be heated.
2. Time required for heating water from the temperature of water entering tank to maximum temperature desired.
3. Temperature of water entering tank.
4. Temperature of water leaving tank.
5. If tank is insulated, what is the thickness and kind of insulation?
6. Power service available.

### Power (Watts) Required For Heating Water in Tanks

The power requirements as listed below are based upon the following assumptions:

Initial Temperature of Water.....	60° F.
Final Temperature of Water.....	160° F.
Time for Heating.....	2 1/4 Hours
Insulated Tank.....	2 Inches Insulation
Uninsulated Tank.....	Rough iron surface

Boiler Capacity Gallons	Boiler Capacity, Lbs. Water	Watts Required With Insulated Tank	Watts Required With Uninsulated Tank
18	150	2070	2940
21	175	2420	3430
24	200	2760	3920
27	225	3100	4400
30	250	3450	4900
35	292	4030	5730
40	334	4600	6550
48	400	5500	7850
63	525	7250	10300
82	685	9450	13400
100	833	11500	16300
120	1000	13800	19600
144	1200	16600	23600
168	1400	19400	27500
192	1600	22100	31400

The following table suggests the size of heaters that is required for various sizes of boilers, when uninsulated and when completely insulated, including the piping; assuming that ten gallons of water are used per day, and that the heater is on the circuit continually. The water is assumed to enter the boiler at 60° Fahrenheit and to be drawn off at 160° Fahrenheit. The size of heater for any other rate of consumption can be determined by allowing 10 watts additional for each additional gallon used per day. It should be understood that these figures will have to be increased when comparatively large quantities of water are drawn off at short intervals. The next larger standard heater should be used in each case.

Capacity of Boiler, Gallons	Uninsulated Galvanized Boiler and Piping	Boiler Insulated with 2" Covering and Piping with 1" Cover
12	550	220
18	600	240
21	650	260
24	700	280
27	775	300
30	850	320
35	900	340
40	950	360
63	1450	500



*“I’m Warm—Are You?”*

For those unexpectedly chilly and damp mornings and evenings—for the cool weather of fall and spring, when it’s too early for furnace fires — for any time and any place where quick warmth means comfort and health-insurance, you’ll find a Cozy-Glow just the thing.

Attach it as you would an electric lamp or iron, turn on the current and in less time than it takes to tell it, the Cozy-Glow will send a beam of heat right to the spot.

Light in weight—easily carried—focusing the heat where wanted, the Cozy-Glow is a source of ready comfort all the year round.

# WESTINGHOUSE WINDOW DISPLAY SERVICE



A REPRODUCTION OF ONE OF THE DISPLAYS WHICH IS TYPICAL OF THE WINDOW DISPLAYS WHICH ARE BEING FURNISHED TO SUBSCRIBERS EACH MONTH

## WESTINGHOUSE WINDOW DISPLAY SERVICE

### For Electrical Retail Stores

**Importance of Window Displays**—The windows of a retail store are silent but effective salesmen working three hundred and sixty-five days a year, twenty-four hours a day. Aggressive merchandisers place a large value on their windows, some department stores spending many thousands of dollars annually on window displays. The demands on the time of the person responsible for dressing the windows of an electrical retail store are frequently so great that he does not have sufficient time to devote to it.

**Westinghouse Service**—Appreciating these facts, the Westinghouse Company has developed a **Monthly Display Service** for the electrical retail store, which completely solves the problem. A typical monthly display is illustrated on the opposite page. The display advertises the store and its service to the community. The name of the manufacturer is mentioned on only two or three of the ten pieces of literature sent each month.

**What the Service Consists of**—A wooden frame (1), frame posters (3), window streamer (1), store cards (2), window posters (2), appliance cards (2), and instruction sheet (1).

**The Frame** is of solid oak, handsomely finished, three panels, 47 inches high, 48 inches wide (with wings extended). It has a removable backing of weatherproof blackboard material, which permits the dealer to write his own message thereon if he so desires.

The name of the dealer is placed on top of the center panel in gilt letters, making it distinctively his own.

**Frame Posters** are lithographed in six or more colors on heavy paper for insertion in the three panels of the frame. They feature some domestic electrical application, tying in whenever possible, with the popular advertising in the national magazines.

**The Window Streamer**, 9x43 inches, is for attaching to the back of the window, or to the glass. It gives the keynote of the display, featuring some timely electrical merchandising idea.

**Store Cards** for use either inside the store or in the window conveying some appropriate message regarding the use of electricity or an electrical device.

**Window Posters** are small cards of varied sizes for pasting on the window. They provide a means of changing the display from time to time as it is not always advisable to put all of the material in the window at one time.

**Appliance Cards** featuring some specific Westinghouse appliances, using the same high grade color scheme and art style as employed on the other portions of the display.

**Instruction Sheet**—Enclosed with each monthly shipment is an instruction sheet showing by photographic illustrations four different methods for attractively arranging the display. Merchandising helps and hints of various kinds are also given from time to time.

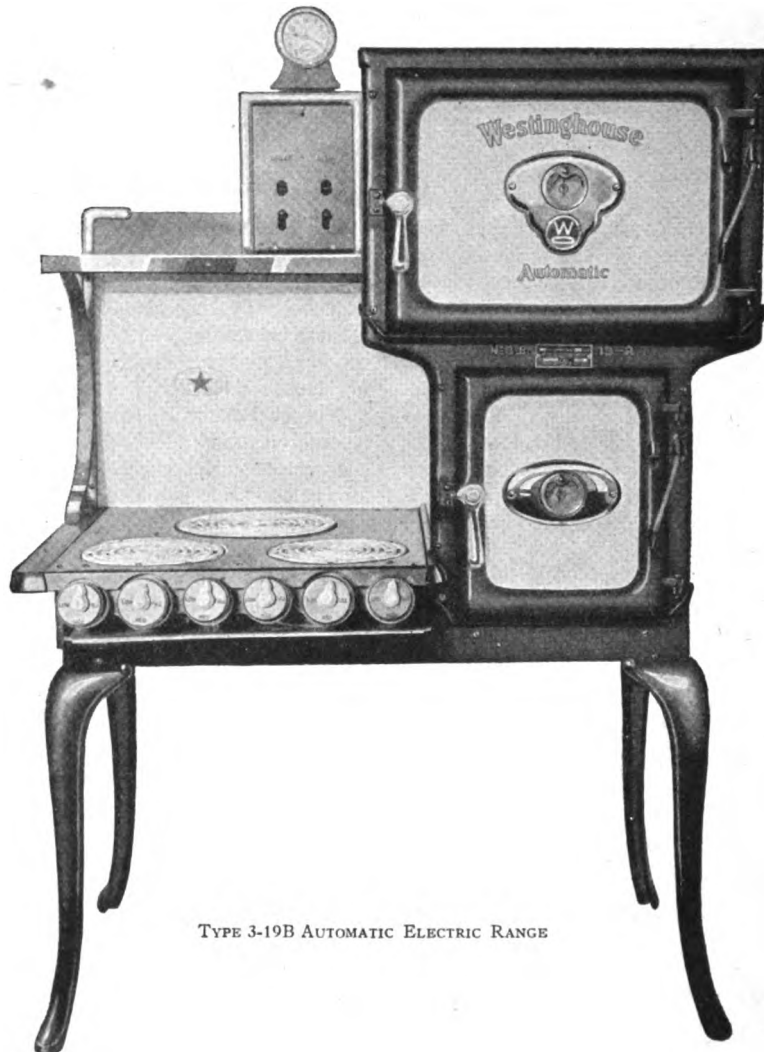
**Cost**—A considerable portion of the expense of this service is being borne by the Company, and it is offered to the electrical retail merchant at only a portion of what it actually costs to produce it.

Monthly Display..... Net Price\*  
Per Annum **\$40 00**

\*When purchased through a Westinghouse Jobber, the service may be billed, at the discretion of the jobber, at the rate of \$4.00 per month for ten months.

## Have You Subscribed?

## AUTOMATIC ELECTRIC COOKING



TYPE 3-19B AUTOMATIC ELECTRIC RANGE

Everyone in the electrical industry should, by this time, be familiar with the general arguments in favor of electric cooking. The cleanliness as well as safety of the electric range is firmly established. The ability of the electric range to save in food over and above older methods of cooking is a fact just as true, although not so firmly established. The positive results obtainable from the electric range day after day are appreciated by all who are familiar with electric cooking.

These are fundamental qualities which you expect from every good electric range. Westinghouse ranges possess them to an unsurpassed degree, adding to them automatic operation.

The automatic mechanism of a Westinghouse range is easy to understand, simple to operate, sure of accomplishment and positive in results.

The use of the automatic feature enables the housewife to be absent from the kitchen for as long as twelve hours before the cooking operation is to start and to remain absent until the food is completely cooked and ready to serve, with the assurance that the food will be properly cooked and yet not burned.

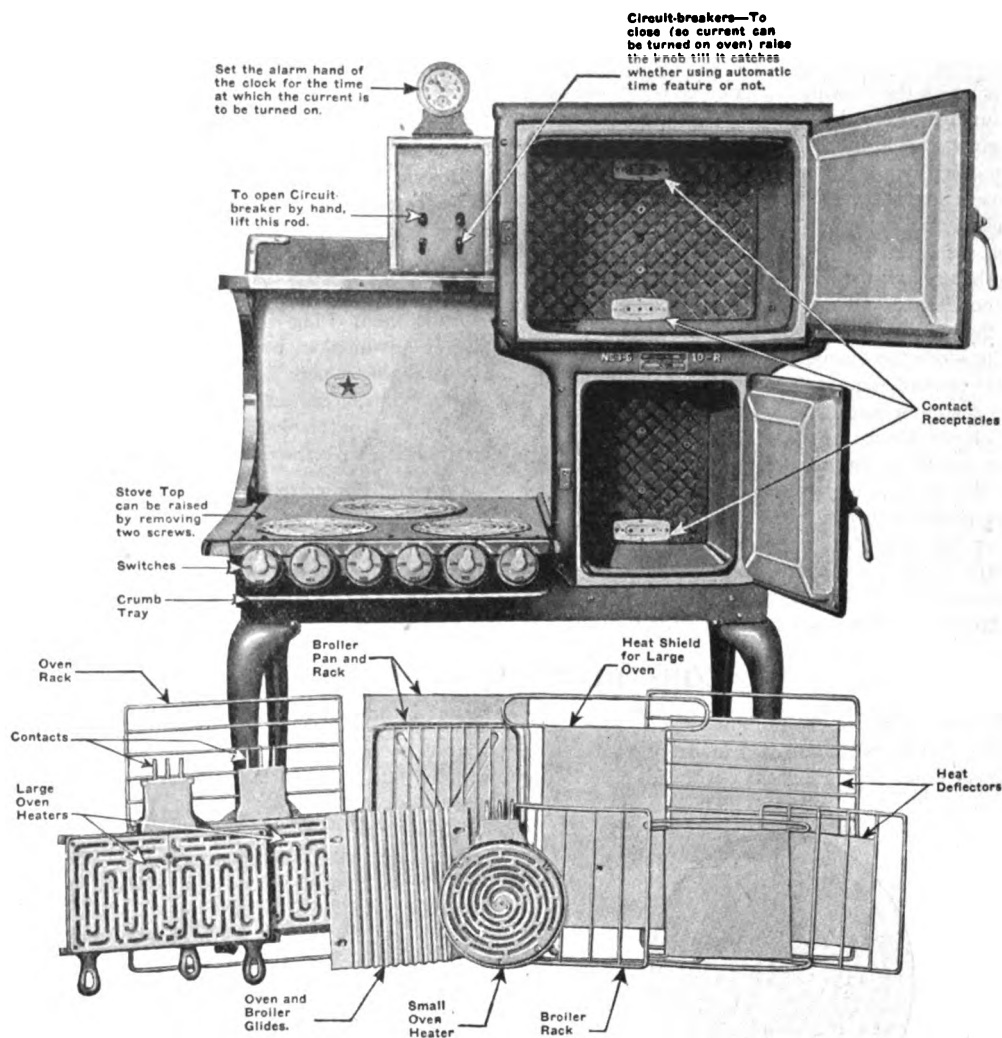
The clock starts the cooking at any desired time. When the desired temperature is reached, the current is turned off by a thermostat. The oven is thoroughly heat-insulated and operates on the heat storage principle.

The Westinghouse automatic range is indeed a Silent Automatic Servant.

The following pages, which describe the various types of ranges in detail, emphasize the distinctive features of Westinghouse electric ranges and their operation.



## TYPE 3-19B RANGES



TYPE 3-19B SHOWING HOW ALL PARTS CAN BE REMOVED FOR THOROUGH CLEANING, AND ACCESSIBILITY OF STOVE TOP CONNECTIONS

The type 3-19B Ranges are full size family cooking ranges for domestic use, and have reached their high perfection in convenience and economy through many years of experience. In addition to the cleanliness, safety, saving in food, and general desirability of cooking with electricity, they have the further advantage of saving a great deal of care trouble and expense by the aid of the Westinghouse exclusive economical features of full automatic control by attached clock and thermostats.

### Distinctive Features

Westinghouse Ranges are approved by the National Board of Fire Underwriters and by the Good Housekeeping Institute.

Meals are cooked automatically—without personal supervision. Clock turns current on, and thermostat turns the current off. Economical in operation—automatic control saves current.

Ovens properly ventilated—no disagreeable odors. All parts accessible for cleaning and repairs. Ovens can be kept clean and sanitary, as all equipment can be easily removed.

Ovens are of high-grade porcelain enamel finish. All oven burners removable.

Ovens heat-insulated with highest grade of mineral wool.

Tight-fitting oven doors with compression latches. Positive sure-acting thermostats and thermometers.

Three-heat snap switches for all burners.

All switches are oxidized. The dials have white enamel letters to show switch position, and heater platform is lettered in white to show burner controlled.

No dirt, soot, nor fumes.

Saving in weights of food cooked.

Superior flavor of electrically cooked food.

## TYPE 3-19B RANGES—Continued

## OPERATION

The ovens utilize the heat storage principle. Current brings the oven up to the desired temperature, after which the cooking is carried on by stored heat, no further current being required. The good results obtained in the modern type of gas ranges can be surpassed by the electric range, owing to the improved internal ventilating of the ovens and the efficient application of heat. Meats, breads, cakes, pies, etc., can be evenly browned to any degree, top, bottom and sides. Surplus moisture is carried off, condensed and deposited in drip cups provided for the purpose, but no heat is allowed to escape.

The stove top burners are not provided with automatic control, but each is equipped with a three-heat switch, a turn of which brings the burners to a red heat almost instantly. Cooking can be done on these burners with the same ease and rapidity as with any other fuel, without the many disagreeable features.

For broiling steaks, chops, etc., only the top burner of the large oven is used. The broiler pan rests on racks, directly beneath the burner, and owing to the fact that the heat can be regulated to three

different degrees, the searing can be controlled perfectly. Meats broiled electrically are free from taint of fuels, and have an attractive flavor, the radiant heat searing the surface and retaining the juices.

Boiling can be more economically accomplished in the small oven or boiler with the aid of the heat storage principle, than on the stove top. In boiling slow-cooking vegetables use very little or no water. Use the Clover-Leaf Set and Cooker Pot in boiling.

**Attachment Plug**—A receptacle is provided on the circuit-breaker box of the automatic ranges for attaching a percolator, iron or other appliance. Any appliance connected to this receptacle can also be operated by the clock at any given time, either in conjunction with the ovens or separately.

**Current Consumption**—Monthly current consumption varies with the requirements of different families. A careful average for many families of four to six persons each, places the current used as 25 kilowatt-hours per person per month, which includes ordinary lights.

## CONSTRUCTION OF BURNERS

All burners are of the radiant type.

The heating wires are laid in deep grooves of a molded porcelain brick that will not check nor

spilled on the burner to pass through. Any food that does not pass through the openings will be rapidly burned off leaving the burner clean and white.

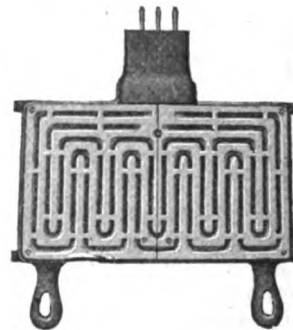
These burners respond very quickly to applied current, and heat directly any vessels placed upon them regardless of contact. In case of a burnout



SMALL OVEN BURNER

crack under extreme heat, and is impervious to water, acids and alkalis.

By a special construction of the grooves the coils are prevented from creeping up when heated and coming in contact with the cooking vessels. They are perforated in many points with small openings, which readily allow any liquid which may be



LARGE OVEN BURNER

they are so simple in construction that any user may replace the burned out coil with a new one in a few minutes with a pair of pliers and a screwdriver.

## TYPE 3-19B RANGES—Continued

## GENERAL CONSTRUCTION

All parts of the range are of metal. The legs, door frames, etc., are castings; other parts are selected sheet steel. The range is sturdy and well constructed throughout; parts are practically unbreakable and can not work loose. Every part is quickly accessible for thorough cleaning and repairs.

Ovens are high-grade porcelain enamel with dark blue finish which increases the efficiency and protects the oven from rusting. They are heavily insulated with the finest grade of mineral wool to reduce to a minimum the loss of heat. A heat shield especially designed, produces an even temperature. All joints are double seamed, and steam tight. Glides fit over studs inside the ovens and are easily removable. Receptacles for the burner contacts are located at the rear of the oven; they are steam tight and need not be removed for cleaning.

Everything can be removed from the oven instantly for cleaning purposes.

**Switches**—All burners are equipped with three-heat switches with gun metal dials, having indications marked with white enamel lettering which makes them easy to read at a considerable distance

from the range. The heater platform is lettered to show which burner each particular switch controls.

The circuit-breaker on the automatic range has carbon arcing tips, which allow the metal part of the switch to open before contact is broken on the carbon points. This prevents the metal contact from corroding and pitting due to arcing, and results in good clean contacts at all times, insuring uniform delivery of current. The circuit-breaker is made in strict accordance with the Underwriters' requirements, is easily accessible, and can be readily taken apart for inspection or repairs.

**Accessibility of Connections**—The panel at the rear of the stove is easily removed, uncovering all receptacles, contacts, wires and connections. The back of the circuit-breaker box is removed in the same manner, making accessible all working parts of the circuit-breaker, clock, switch, and every wire terminating in this box.

**Stove Top**—By removing two small screws the top can be lifted up and back for repair or inspection, disclosing every contact and connection to the burner and switches.

## FINISH

These ranges with their clear cut and well balanced lines present an exceedingly attractive appearance and a harmony of color, which is thoroughly appreciated by the discriminating buyer.

All sheet metal used on the outside of the range is of the best grade obtainable, and has a very high

grade black baked japan finish. The thermometer plates, clock, snap switches, shelf trimming, and corner supports, are nickel-plated and polished. The side and back splashes, crumb tray, and door panels, are of white porcelain enamel, which can be easily cleaned.

## COMBINATION GAS AND ELECTRIC RANGES

The type 3-19B and 2-19B can be furnished with combination gas and electric equipment. These are exactly the same as the all electric, with the exception of the stove top burners, which in the combination ranges are replaced by four gas burners. This makes possible the use of gas burners on the stove top, and electricity for the ovens.

One gas burner is extra large, known as the giant burner, in the center of which is a separate and distinct burner of very small capacity used for simmering. Each burner on the range is controlled by an individual lever valve.

When ordering, specify whether natural or artificial gas is used.

## INSTRUCTIONS

A complete and comprehensive instruction book is furnished with each range. To secure all the benefits of electric equipment, and to make cooking thoroughly satisfactory, we urge that the few

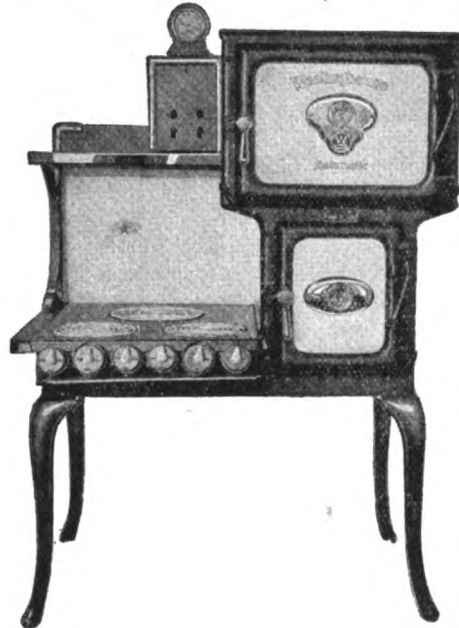
simple directions given in this book be followed. Complete wiring diagram is on the back of every range. Instruction card, embodying a few "don'ts" is also furnished with each range.

## GUARANTEE

Each range is fully guaranteed against mechanical or electrical defects for a period of one year from date of purchase by the user. Should any part prove defective within one year, it will be replaced or re-

paired free of charge. In all cases, apparatus requiring repairs should be referred to our local service representatives, and where in line with our guarantee, the service rendered will be free of charge.

**TYPE 3-19B AUTOMATIC ELECTRIC RANGE**



**Total Maximum Input**—8000 watts.  
**Average Maximum Demand**—4000 watts.  
**Heat Control**—Three-heat indicating snap switch for each burner.  
**Automatic Features**—The clock automatically starts the cooking in ovens—the heat indicator automatically turns off the current.

**Dimensions of Range**—43x25 inches—59 inches total height.  
**Height of Cooking Surface**—31 inches.  
**Size of Ovens**—Large, 18½x13½ inches—16 inches deep; small, 10¾ x 13½ inches—11½ inches deep.

Volts	Circuit	Wiring	Approx. Shipping Weight, Pounds	Finish	STYLE No.	
					Left-Hand Ovens	Right-Hand Ovens
110-220	a-c. or d-c.	3	440	Black	327678	327680
200-240	a-c. or d-c.	2	440	Black	327679	327681
110-220	a-c. or d-c.	3	440	{ White Enamel	327501	327503
200-240	a-c. or d-c.	2	440	{ White Enamel	327502	327504

**TYPE 3-19B AUTOMATIC COMBINATION RANGE**

**Total Maximum Electrical Input**—4000 watts.  
**Heat Control**—Three-heat indicating snap switch for each electric burner.  
**Automatic Features**—The clock automatically starts the cooking in ovens—the heat indicator automatically turns off the current—gas burners with automatic lighter.  
**Dimensions of Range**—43x25 inches—59 inches total height.  
**Height of Cooking Surface**—31 inches.  
**Size of Ovens**—Large, 18½ x 13½ inches—16 inches deep; small, 10¾ x 13½ inches—11½ inches deep.

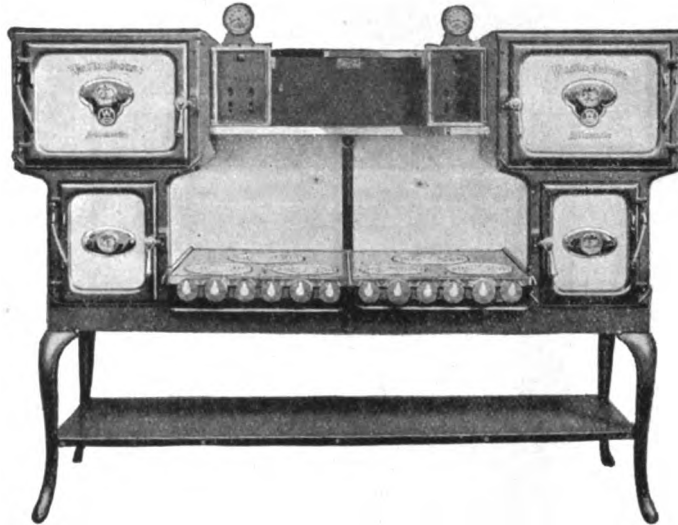


STYLE No.		Approx. Shipping Weight, Pounds	Wiring	Volts	Circuit
Left-Hand Ovens	Right-Hand Ovens				
327710	327712	440	3	110-220	a-c. or d-c.
327711	327713	440	2	200-240	a-c. or d-c.

**Order by Style Number and Specify Exact Voltage**

8-705A

## TYPE 3-19B DOUBLE AUTOMATIC ELECTRIC RANGE



**Total Maximum Input**—16000 watts.  
**Average Maximum Demand**—8000 watts.  
**Heat Control**—Three-heat indicating snap switch for each burner.  
**Automatic Features**—The clock automatically starts the cooking in ovens—the heat indicator automatically turns off the current.

**Dimensions of Range**—84 x 28 inches—61 inches total height.  
**Height of Cooking Surface**—31 inches.  
**Size of Ovens**—Large, 18½ x 13½ inches—16 inches deep; small, 10¾ x 13½ inches—11½ inches deep.  
 Also furnished with one gas top and one electric top.

Volts  
110-220  
200-240

Circuit  
a-c. or d-c.  
a-c. or d-c.

Wiring  
3  
2

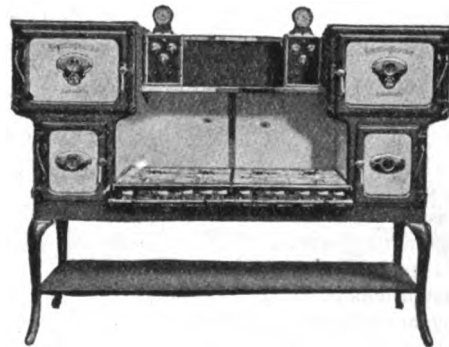
Approx. Shipping  
Weight, Pounds  
780  
780

Automatic  
Automatic

Style No.  
327857  
327858

## TYPE 3-19B DOUBLE AUTOMATIC COMBINATION RANGE

**Total Maximum Input**—8000 watts.  
**Heat Control**—Three-heat indicating snap switch for each burner.  
**Automatic Features**—The clock automatically starts the cooking—the heat indicator automatically turns off the current—gas burners with automatic lighter.  
**Dimensions of Range**—84 x 28 inches—61 inches total height.  
**Size of Ovens**—Large, 18½ x 13½ inches—16 inches deep; small, 10¾ x 13½ inches—11½ inches deep.



Volts  
110-220  
200-240

Circuit  
a-c. or d-c.  
a-c. or d-c.

Wiring  
3  
2

Approx. Shipping  
Weight, Pounds  
780  
780

Automatic  
Automatic

Style No.  
327863  
327864

**Order by Style Number and Specify Exact Voltage**

## TYPE 2-19B HALF-AUTOMATIC ELECTRIC RANGE



**Total Maximum Input**—7000 watts.

**Average Maximum Demand**—3500 watts.

**Heat Control** — Three-heat indicating snap switch for each burner.

**Automatic Features**—The heat indicator automatically turns off the current.

**Dimensions of Range**—32 x 24½ inches—34 inches total height.

**Height of Cooking Surface**—34 inches.

Volts	Circuit	Wiring	Approx. Shipping Weight, Pounds	Style No.
110-220	a-c. or d-c.	3	255	327948
200-240	a-c. or d-c.	2	255	327949
High-Back Warming Shelf, White Porcelain Enamel.				

**Size of Oven**—18½ x 13½ inches—16 inches deep. There is a convenience outlet on the side of the Circuit Breaker Box, where an electric iron or other appliance can be attached.

These ranges can be furnished semi-automatic. The semi-automatic range is equipped with automatic thermostats connected to call bell which attracts operator when predetermined temperature has been reached.

## TYPE 2-19B HALF-AUTOMATIC COMBINATION RANGE

**Total Maximum Input**—3000 watts.

**Heat Control**—Three-heat indicating snap switch for each burner.

**Automatic Features**—The heat indicator automatically turns off the current—gas burners with automatic lighter.

**Dimensions of Range**—32x24½ inches—34 inches total height.

**Height of Cooking Surface**—34 inches.

**Size of Oven**—18½x13½ inches—16 inches deep.

Volts	Circuit	Wiring	Approx. Ship. Weight, Lbs.	Style No.
110-220	a-c. or d-c.	3	255	327952
200-240	a-c. or d-c.	2	255	327953
High-Back Warming Shelf, White Porcelain Enamel.				



**Order by Style Number and Specify Exact Voltage**

## AUTOMATIC TIME SWITCH AND CLOCK FOR TYPE 2-19B RANGE

Type 2-19B Half-Automatic Range has automatic temperature control but no automatic time control to turn on the current at a predetermined time. To provide this feature the type 2-19B Automatic Time Switch is supplied.

The outfit consists of a single-pole double-throw knife switch contained in a metal wall box, and a clock. All parts are interchangeable.

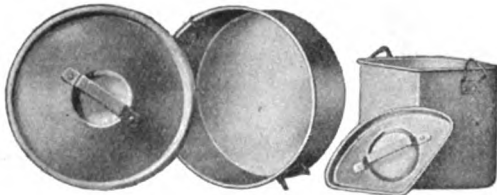
The outfit mounts on the wall directly above and to the right of the range. It occupies only 7 $\frac{1}{2}$  by 7 $\frac{5}{8}$  inches and is so light that it is very easy to mount.

**Application to Standard Ranges**—The use of this switch involves some changes in the wiring of the range. If the switch is ordered with the range the necessary changes will be made in the range at the factory without charge. For ranges already in use diagram of proper connections will be furnished.



AUTOMATIC TIME SWITCH AND CLOCK  
STYLE NUMBER 269231

## ELECTRIC COOKING ACCESSORIES FOR TYPE 3-19B RANGE



COOKER POT

CLOVER-LEAF VESSEL

Great economy can be effected in electric ranges by doing all boiling in the ovens. The clover-leaf set and the cooker pot are built especially for these ranges. The vessels are of specially heavy

gauge aluminum, well made and very substantial.

**Clover-Leaf Set**—The clover-leaf set consists of three triangular vessels, each holding two quarts. All three vessels can be placed in the small oven of the type 3-19B range so that three vegetables can be boiled separately at the same time.

**Cooker Pot**—The cooker pot is a round 2 $\frac{1}{2}$  quart vessel which fits over the clover-leaf set or can be used separately. It is useful in preparing boiled meats, stews, etc.

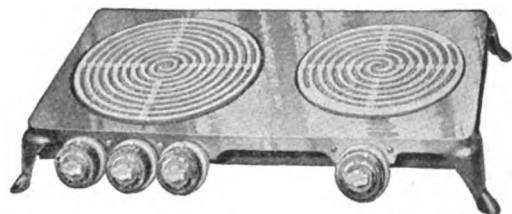
Description	Style No.
Clover-Leaf Set (three vessels)	278401
Cooker Pot	278402

## HOT PLATE

These Hot Plates are designed for apartment houses, cafeterias and restaurants. Finished in black japan.

**Heat Control**—The 8-inch heater has a three-heat switch. In the 10-inch heater three separate switches are used. These light up an area 6 inches, 8 inches, or 10 inches in diameter. Each 10-inch heater is therefore really three plates in one.

Style number includes hot plate with switches as illustrated.



TYPE 22 TABLE RANGE

Volts	Maximum Watts	Wiring	Approx. Shipping Weight	Style No.
110-220	3000	3	30	266968
200-240	3000	2	30	266970

Order by Style Number and Specify Exact Voltage

8-708A

**TYPE 515 RANGE**



TYPE 515 ELECTRIC RANGE



TYPE 515 ELECTRIC RANGE WITH HIGH-BACK WARMING SHELF (EXTRA)

The 515 range was designed to meet the needs of those who desire a small electric range. It is especially adapted for use in apartment houses, seashore homes, and kitchenettes as it takes up only a small amount of floor space. It is neat, compact and efficient.

The extremely simple and practical construction of the 515 assures easy accessibility to all parts whenever it is necessary to clean the range or make minor repairs.

The hot plates are controlled by three heat snap switches which clearly indicate the three temperatures which may be obtained.

The oven is fully equipped with oven heaters, racks, broiler and tray.

The oven door opens down forming a shelf on which the food may be rested before placing it in the oven.

**Total Maximum Input—5000 watts.**

**Average Maximum Demand—2500 watts.**

**Dimensions of Range—31 inches high—top 24½x16½ inches.**

**Height of Cooking Surface—31 inches.**

**Size of Oven—12 x 16 x 12 inches deep.**

Volts  
110-220  
200-240

Wiring  
3  
2  
High-Back Warming Shelf

WEIGHT	
Net	Shipping
80	100
80	100

Style No.  
327884  
327886  
283387

**Order by Style Number and Specify Exact Voltage**



## WESTINGHOUSE ELECTRIC FANS

For years every effort has been made to better the mechanical and electrical characteristics of Westinghouse Electric Fans. So successful have these efforts been, that the name "Westinghouse" on a fan is now synonymous with mechanical excellence. The air delivery of the fans is large. They run almost noiselessly. They require little attention—one oiling suffices for a season. Their efficiency is so high, and their durability so great, that their cost of operation and maintenance is small. No known means of increasing their efficiency and effectiveness has been neglected.

The mechanical details perfected, an improvement has now been made in the finish. For a long time, a dull black enamel has been standard for fans. It had much to recommend it; it would not show blemishes. It was easily cleaned; and it lent to the fan an air of dignity and efficiency. In the home, however, it did not always harmonize with the furnishings.

### The Home Fan

And so the home fan has been brought out. Instead of the familiar and funeral black, its finish is a beautiful ivory enamel. It will harmonize with the decorations of any room in the home; and such is its attractiveness that, far from appearing a mere piece of machinery, it is a good-looking addition to the furnishings.

The ivory finished fan is furnished at present only in the 10-inch oscillating type, which is the one generally used in the home. The combination of strong selling points embodied in the fan's mechanical superiority and attractive appearance seem to justify the prediction that the home fan will prove to be the best seller in the fan line this season.

For home and commercial applications which require a larger fan, the 12 and 16-inch fans, using the 6 pole, slow speed motor, and the deep pitch four blade propeller, are now available. These two features give not only noiseless operation, but exceptionally high comparative efficiency, as may be seen from the following table:

	Maximum rpm	Watts input to blades	Air Delivery Cu. ft. per Min.
12-inch 6 blade	1050	10.3	850
12-inch 4 blade—high speed	1600	13.2	850
12-inch 4 blade—slow speed	1150	9.5	950

The slow speed 16-inch fan, turning over at 1050 rpm, delivers 1725 cubic feet of air per minute with 28 watts input to the blades.

These 12 and 16-inch fans are used mostly in stores, hospitals, theatres, and office buildings, and so are furnished in dull black. Black is, perhaps, more appropriate for these applications than the ivory finish, intended primarily for fans used in the home, would be.

### Packing

All fans are packed in strong substantial boxes, and are held in place by substantial braces.

Every package contains a guarantee card and a card giving full instructions for operation and care.

Dimensions of packing cases are given in the following table:

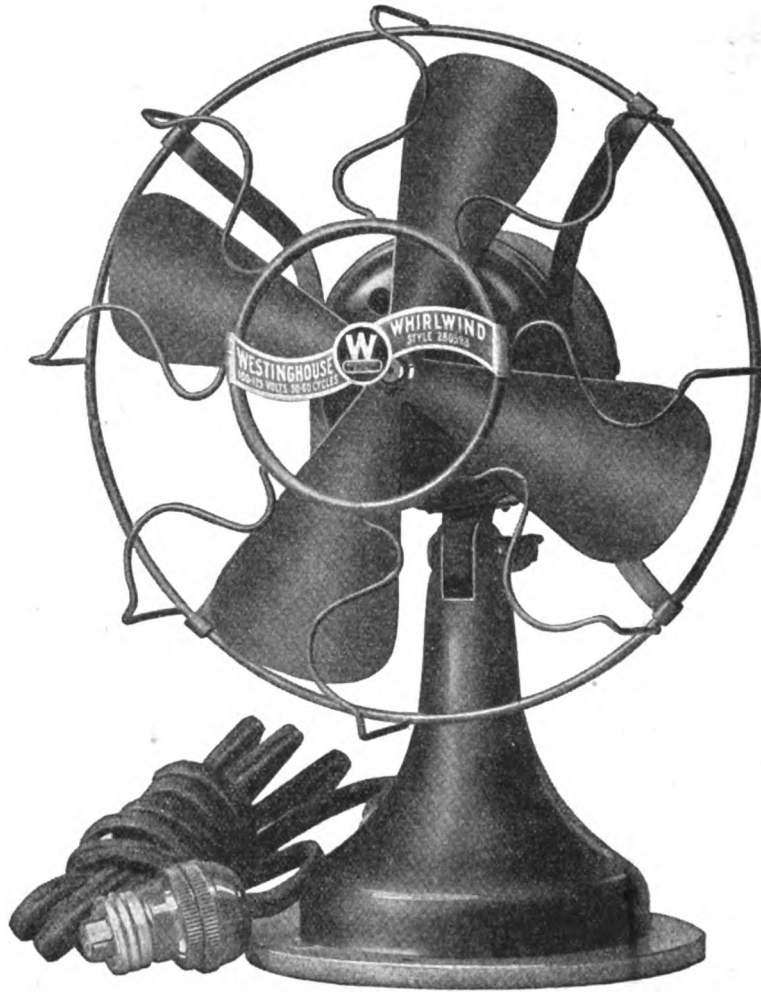
DIMENSIONS OF SHIPPING CASES—INCHES			
Type	Diameter Inches	Complete in One Box	
Non-Oscillating	8	10½ x 7½ x 12½	.....
	10	14½ x 10 x 14½	.....
	12	17 x 12 x 17	.....
	16	22 x 12 x 22	.....
Oscillating	10	14½ x 11½ x 16	.....
	12	18½ x 13 x 16½	.....
	16	22 x 14 x 24	.....
Exhaust	12	20 x 13 x 18	.....
	16	22 x 14 x 22	.....
		For Motor Body	For Stem, Etc.
Ceiling Gyrating	56	17 x 14 x 14	44 x 9 x 9
	Ceiling	25½ x 15½ x 19½	43½ x 3½ x 3

### Guarantee

The company agrees with the purchaser of each Westinghouse fan to make good by repair or replacement, when delivered at the factory (Newark, N. J.) or at a Westinghouse service repair shop\*, transportation prepaid, any defect in material or manufacture of such a fan not caused by misuse or neglect, provided that the original factory nameplate shall be on such fan motor at the time the claim is made and that all defective parts shall be referred to the Company before any claim for repair or replacement shall be allowed. No claim will be considered for defective fans when customers tamper with them, or attempt repairs on them without written authorization from the Company. It is also required that the fan motor shall have been operated on circuits corresponding to the nameplate marking of the motor. This guarantee continues for one year from date of sale to user.

\*For addresses, see inside front cover.

## WESTINGHOUSE WHIRLWIND 8-INCH FANS



A-C. WHIRLWIND FAN

This popular priced fan finds a large field of usefulness in homes and offices where low cost is of importance. It has the same pleasing outlines as the more expensive fans, its low price being due to the absence of speed control switch, and the omission of other refinements not required for durability.

**Construction**—Base, motor body and end brackets are of drawn steel, blades and guard of steel.

**Finish**—Dull black on all parts.

**Speeds**—One only.

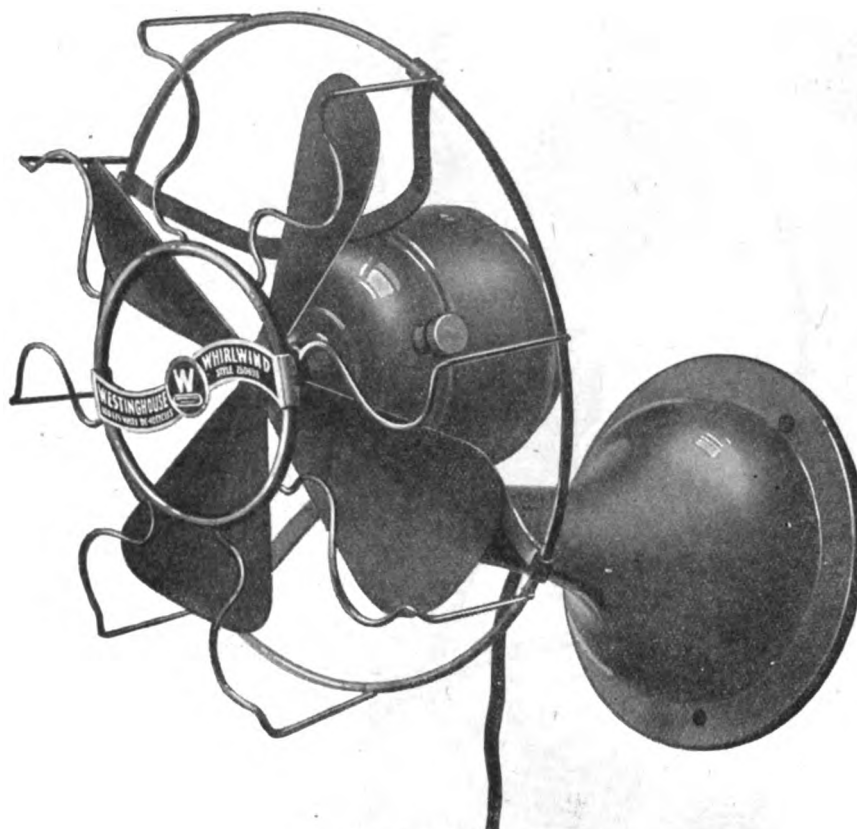
**Control**—Separable plug to turn current on or off.

**Lubrication**—Grease cups with spring-operated felt wicks, requiring attention only once a season.

**Guard**—Steel supported by pressed steel arms.

**Hinge Joint**—Fan can be tilted 15 degrees forward, or 90 degrees backward, for wall mounting. Adjustment clamped by a wing nut.

## WESTINGHOUSE WHIRLWIND 8-INCH FANS—Continued



D-C. WHIRLWIND FAN

**Packing**—Each fan is packed in a separate box. Standard package consists of ten fans. Bulk package consists of five standard packages.

Style number and price include fan complete with separable attachment plug and 6-foot cord.

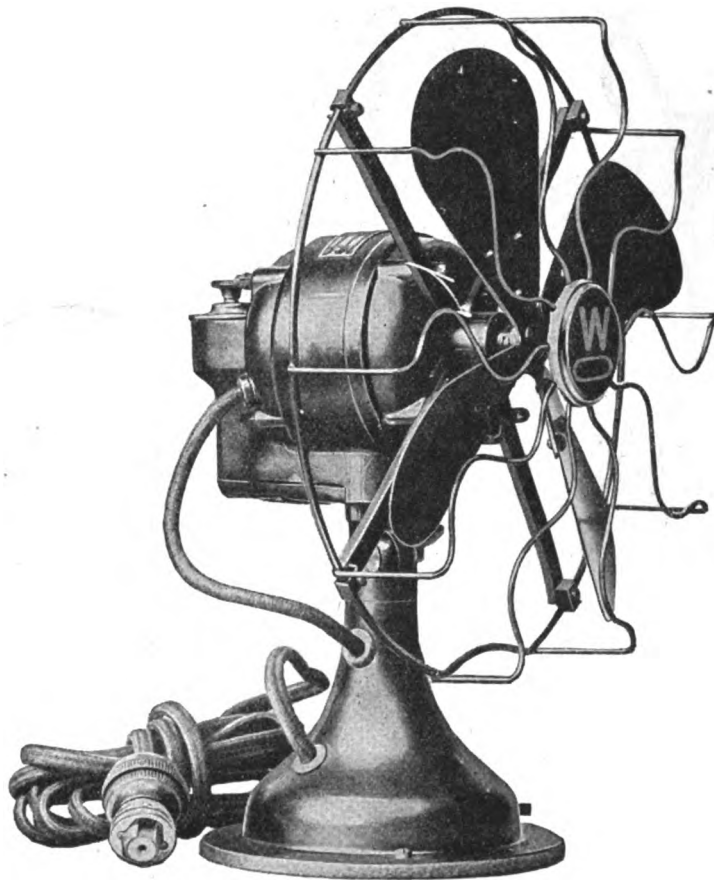
## PRICES

Frequency Cycles	Number of Blades	Volts	Watts at High Speed*	Average rpm*	Cu. Ft. of Air per Minute†	APPROX. Net	WT., LBS. Boxed	Style No.	Net Retail Price‡
60	4	100-120	30	1575	345	5½	11	280598	\$10 00
50	4	100-120	27	1900	415	5	11	280729	10 00
40	4	110-125	40	1840	405	5	10½		
25-30	4	100-125	31	1800	395	5	10½	280698‡	10 00
D-C.	4	100-125	33	1950	425	5	10½		
D-C.	4	24-32	33	1950	425	5	10	280727	10 00

**220-Volt Fans** { For 220-Volt a-c. fans add \$1.50 to retail prices given above.  
 { For 220-Volt d-c. fans add \$1.50 to retail prices given above.  
 \*Watts, speed, and air delivery may vary 10 per cent from figures given.  
 †For method of measuring air delivery see page 1171.  
 ‡These fans have series motors.  
 §For terms of delivery see page 1178.

*Order by Style Number*

## 10-INCH DESK-AND-BRACKET FANS



OSCILLATING 10-INCH A-C. FAN

**Construction**—Base motor body and end brackets are each drawn from sheet steel, except the frame part of the oscillator, in which a die casting forms the motor body and oscillator case. The oscillating mechanism is the same as that on the larger fans, except it is more compact. Induction motors used for 60-cycle fans, series motors for 40-cycle, 50-cycle, and 25-30-cycle a-c and d-c. fans.

**Finish**—Standard finish is dull black or an attractive ivory tint,\* smooth and lustrous—no joints, ridges, or rough spots. Fan blades are steel, lacquered a dull black. Guard is steel, finished in black to match the rest of the fan.

**Speeds**—Three: 1, Off; 2, High speed; 3, Medium speed; 4, Low speed.

**Lubrication**—Grease cups with spring-operated felt wicks, requiring attention only once a season.

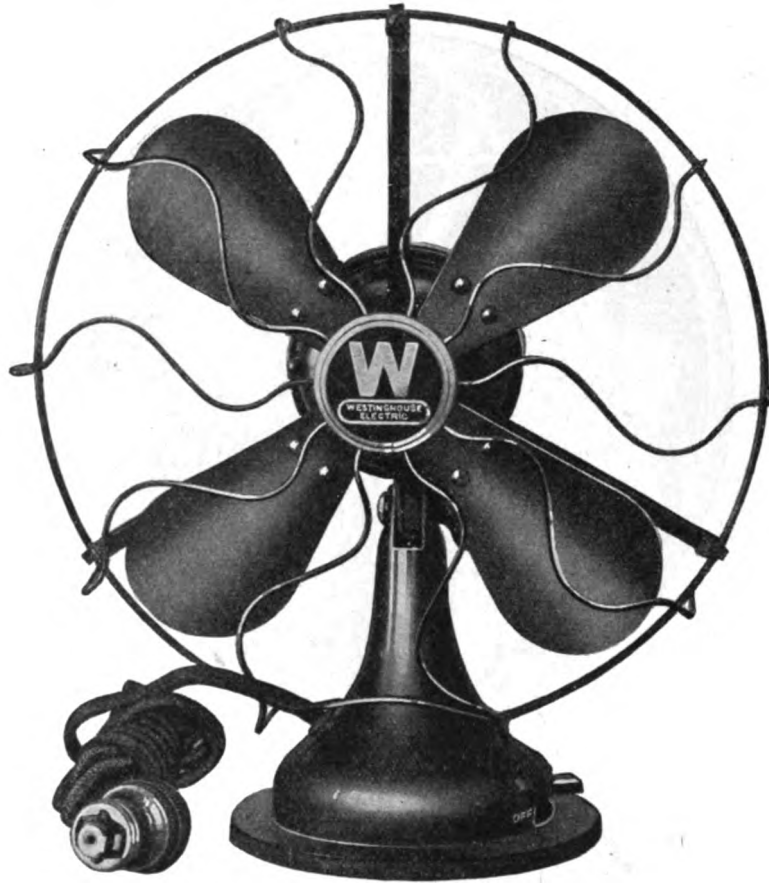
**Hinge Joint**—Non-oscillating fan can be tilted 15 degrees forward or 90 degrees backward. Oscillating fan can be tilted 20 degrees forward or backward in desk position, and 20 degrees forward in bracket position, with a set screw to prevent slipping beyond this angle. Adjustment clamped by a wing nut.

**Arc of Oscillation**—90 degrees as shipped. Can be changed easily to 45 degrees.

**Style number and price** include fan complete with separable attachment plug and 8-foot cord.

\*See page 1166 for a full description of the ivory finished fan.

10-INCH DESK-AND-BRACKET FANS—Continued



NON-OSCILLATING 10-INCH D-C. FAN

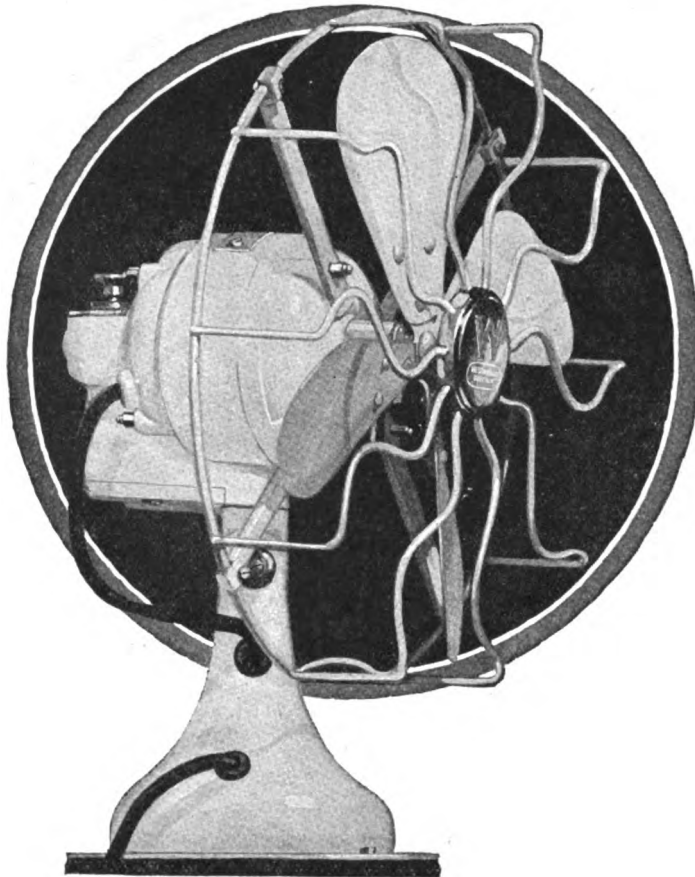
PRICES

Frequen- cy Cycles	No. of Blades	Volts	Watts at High Speed*	Average rpm*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS. Net Boxed	Style No.	Net Retail Price‡
<b>Non-Oscillating Fans</b>								
60	4	100-120	35	1450, 1250, 1000	550	7 16	241842	\$18 50
50	4	100-120	35	1550, 1400, 1250	540	7 16	274734‡	18 50
40	4	110-125	24	1400, 1300, 1200	485	7 16	272852‡	18 50
25-30	4	100-125	29	1425, 1275, 1125	495	7 16		
D-C.	4	100-125	35	1650, 1450, 1250	425	7 16	241835	18 50
D-C.	4	24-32	35	1650, 1450, 1250	425	7 16		
<b>Oscillating Fans</b>								
60	4	100-120	36	1450, 1250, 1100	550	9 19 1/2	363329**	24 00
60	4	100-120	36	1450, 1250, 1100	550	9 19 1/2	241853	23 00
50	4	100-120	36	1525, 1375, 1225	530	9 19 1/2	274735‡	23 00
40	4	110-125	26	1375, 1275, 1175	475	8 18 1/2	272854‡	23 00
25-30	4	100-125	30	1400, 1250, 1100	485	8 18 1/2		
D-C.	4	100-125	36	1625, 1525, 1225	565	8 18 1/2	363328**	24 00
D-C. to 40	4	100-125	36	1625, 1525, 1225	565	8 18 1/2		
D-C.	4	24-32	36	1625, 1525, 1225	565	8 18 1/2	241846	23 00

**220-Volt Fans** ( For 220-Volt a-c. fans add \$1.50 to retail prices given above.  
 For 220-Volt d-c. fans add \$1.50 to retail prices given above.  
 220-Volt and 30-volt fans are not usually carried in stock.  
 \*Watts, speed, and air delivery may vary 10 per cent from figures given.  
 \*\*Note: Style numbers 363328 and 363329 are enameled in an old ivory finish, with nickel plated trimming.  
 †For method of measuring air delivery see page 1171.  
 ‡These fans have series motors.  
 ¶For terms of delivery see page 1178.

Order by Style Number

## THE HOME FAN



IVORY-FINISH 10-INCH OSCILLATING FAN

The name that has been conferred upon this fan is in itself a complete description. Many things contribute to make the fan wear the title honorably.

The fan's appearance is extremely attractive, the rich ivory-colored finish and the graceful lines imparting an air of daintiness and refinement. And the fact that the color is attractive is not its sole virtue: that it will harmonize with the decorations of any room is equally important.

The new finish removes the last objection that any housewife could have to a fan—that it appeared too much like a piece of machinery.

Mechanically, the fan is a duplicate of the

standard black-finish ten-inch fan. It is furnished only in the oscillating type. Merely loosening a thumb-nut makes it possible to convert the fan from a desk to a bracket type, or back again. The arc of oscillation is 90 degrees, and a simple mechanical adjustment is all that is necessary to change it to 45 degrees.

High electrical and mechanical efficiency make the air delivery large, and the cost of operation small. The only attention required is an oiling once a season.

The fan is attractive—no trouble to operate—effective—and economical.

Frequency Cycles	Number of Blades	Volts	Watts at High Speed*	Average rpm*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS. Net	APPROX. WT., LBS. Boxed	Style No.	Net Retail Price‡
60	4	100-120	36	1450, 1250, 1100	550	9	19½	363329	\$24 00
d-c. to 40	4	100-125	36	1625, 1525, 1225	565	8	18½	363328	24 00

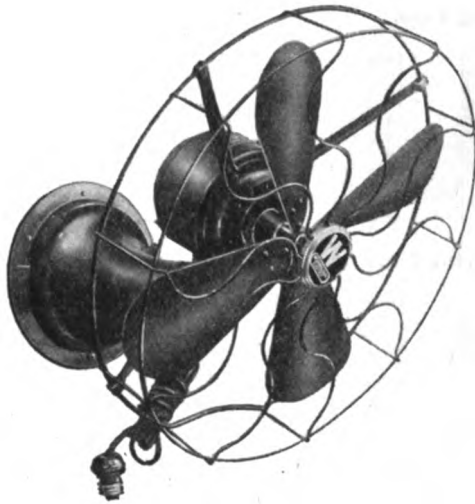
\*Watts, speed, and air delivery may vary 10 per cent from figures given.

†For method of measuring air delivery see page 1171.

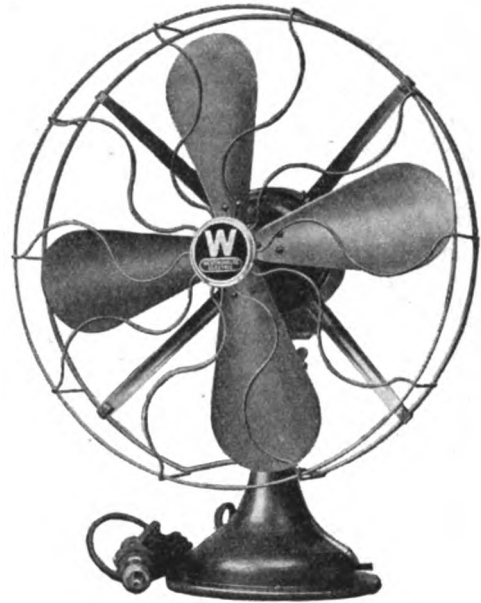
‡For terms of delivery see page 1178.

*Order by Style Number*

## 12-INCH AND 16-INCH DESK-AND-BRACKET FANS



12-INCH NON-OSCILLATING FAN



16-INCH NON-OSCILLATING FAN

**Construction**—Base, motor body and end brackets are each drawn from a disc of 5-64-inch sheet steel. Induction motors used for 60-cycle, 50-cycle and 40-cycle a-c. fans. Series motors for 25-cycle a-c. and for d-c. fans.

**Finish**—Standard finish is dull black, smooth and lustrous—no joints, ridges, or rough spots. Fan blades are finished in a dull black.

**Speeds**—Three—1, Off; 2 Low speed; 3, Medium speed; 4, High speed. Motors start on any speed.

**Bearings**—“Westinghouse bronze” bushings, cast into housings which are screwed to the motor end brackets, to assure proper alignment of the rotor.

**Lubrication**—Grease cups with spring-operated felt wicks, requiring attention only once a season.

**Guard**—Heavy steel, finished in dull black, supported by four pressed steel arms.

**Swivel-and-Hinge Joint**—The non-oscillating fans can be tilted forward 15 degrees, backward 90 degrees, and rotated 240 degrees. The oscillating fans can be tilted forward or backward 20 degrees in desk position, and 20 degrees forward in bracket position, with a set screw to prevent slipping beyond this angle. Adjustment clamped by a wing nut.

**Arc of Oscillation**—Arranged for 90 degrees when shipped. Can be changed easily to 45 degrees.

**Style number and price** include fan complete with separable attachment plug and 8-foot cord.

Frequency Cycles	No. of Blades	Volts	Watts at High Speed*	Average rpm.*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS.		Style No.	Net Retail Price‡
						Net	Boxed		
60	4	100-120	46	1025, 850, 700	850	15 ¼	28 ¼	315734	\$23 50
60	4	100-120	46	1585, 1460, 1230	845	15	28	162625	23 50
50	4	100-120	45	875, 790, 700	730	15 ¼	28 ¼	315732	23 50
50	4	100-120	45	1390, 1250, 1150	740	15	28	163537	23 50
40	4	110-125	43	990, 850, 700	800	15 ¼	28 ¼	315730	24 50
40	6	110-125	43	990, 850, 700	800	15 ¼	28 ¼	162624	24 50

220-Volt Fans { For 220-Volt a-c. fans add \$2.00 to retail prices given above.  
 { For 220-Volt d-c. fans add \$2.50 to retail prices given above.  
 30-Volt D-C. Fans—Fans for 24 to 32 Volts d-c. will be furnished at same prices as 100-125-Volt d-c. fans.  
 220-Volt and 30-Volt fans are not usually carried in stock.  
 6-blade fans supplied until stock of parts is exhausted.  
 \*Watts, speed, and air delivery may vary 10 per cent from figures given.  
 †For method of measuring air delivery see page 1171.  
 ‡For terms of delivery see page 1178.

*Order by Style Number*

18-106A

12-INCH AND 16-INCH DESK-AND-BRACKET FANS—Continued

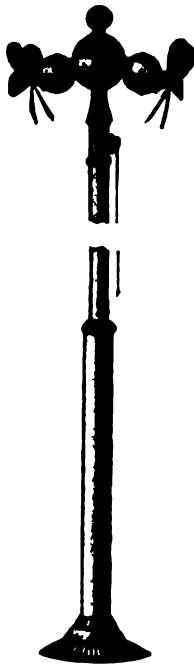
Frequency Cycles	Number of Blades	Volts	Watts at High Speed*	Average rpm <sup>†</sup>	Cu. Ft. of Air per Minute†	APPROX. WT., Lb. Net	APPROX. WT., Lb. Boxed	Style No.	Net Retail Price‡
<b>12-Inch Non-Oscillating Fans</b>									
25-30	4	100-125	36	1050, 800, 500	870	13½	26¼	315728**	25 00
25-30	4	100-125	30	1600, 1250, 850	850	13	26	162820**	25 00
D-C	4	100-125	31	1150, 925, 680	950	13½	26¼	315726	23 50
D-C	4	100-125	27	1600, 1300, 1000	850	13	26	162837	23 50
D-C	4	24-32	31	1150, 925, 675	950	13½	26¼	315725	23 50
D-C	4	24-32	27	1600, 1300, 1000	850	13	26	160175	23 50
<b>12-Inch Oscillating Fans</b>									
60	4	100-120	48	1025, 900, 800	850	16½	31¼	315745	30 00
60	4	100-120	48	1600, 1480, 1330	850	16½	31	164848	30 00
50	4	100-120	47	875, 825, 790	730	16½	31¼	315743	30 00
50	4	100-120	47	1390, 1300, 1220	740	16½	31	164867	30 00
40	4	110-125	45	990, 870, 800	800	16½	31¼	315741	31 00
25-30	4	100-125	38	1050, 800, 500	870	14½	28½	315739**	31 50
25-30	4	100-125	32	1600, 1250, 850	850	14	28½	164860**	31 50
D-C	4	100-125	32	1150, 925, 675	950	14½	28½	315737	30 00
D-C	4	100-125	28	1600, 1300, 1000	850	14	28½	164854	30 00
D-C	4	24-32	32	1150, 925, 765	950	14½	28½	315736	30 00
D-C	4	24-32	28	1600, 1300, 1000	850	14	28½	160176	30 00
<b>16-Inch Non-Oscillating Fans</b>									
60	4	100-120	86	975, 800, 500	1600	19½	36½	321336	27 00
60	4	100-120	94	1500, 1250, 1000	1600	20	37	162831	27 00
50	4	100-120	80	875, 800, 625	1400	19½	36½	321334	27 00
50	4	100-120	74	1300, 1150, 1000	1400	20	37	163540	27 00
40	4	100-125	90	1000, 900, 800	1625	19½	36½	321332	28 00
25-30	4	100-125	70	1050, 850, 650	1725	15½	32½	321330**	28 00
25-30	4	100-125	70	1600, 1250, 950	1725	16	33	162822**	28 50
D-C	4	100-125	63	1050, 850, 650	1725	15½	32½	321328	27 00
D-C	4	100-125	64	1600, 1250, 1000	1725	16	33	162839	27 00
D-C	4	27-32	63	1050, 850, 650	1725	15½	32½	321327	27 00
D-C	4	27-32	64	1600, 1250, 1000	1725	16	33	287024	27 00
<b>16-Inch Oscillating Fans</b>									
60	4	100-120	88	975, 850, 725	1600	20½	40½	321347	35 00
60	4	100-120	96	1500, 1325, 1050	1600	21	41	164851	35 00
50	4	100-120	82	875, 800, 700	1400	20½	40½	321345	35 00
50	4	100-120	76	1300, 1250, 1150	1400	21	41	164870	35 00
40	4	110-125	92	1000, 950, 875	1625	20½	40½	321343	36 00
25-30	4	100-125	72	1050, 850, 650	1725	17½	37½	321341**	36 50
25-30	4	100-125	72	1600, 1250, 950	1725	18	38	164862**	36 50
D-C	4	100-125	65	1050, 850, 650	1725	17½	37½	321339	35 00
D-C	4	100-125	66	1600, 1250, 1000	1725	18	38	164856	35 00
D-C	4	27-32	65	1050, 850, 650	1725	17½	37½	321338	35 00
D-C	4	27-32	66	1600, 1250, 1000	1725	18	38	287045	35 00

220-Volt Fans { For 220-Volt a-c. fans add \$1.50 to retail prices given above.  
 For 220-Volt d-c. fans add \$1.50 to retail prices given above.  
 30-Volt D-C. Fans—Fans for 24 to 32-Volts d-c. will be furnished at same prices as 100-125-Volt d-c. fans.  
 220-Volt and 30-Volt fans are not usually carried in stock.  
 6-blade fans supplied until stock of parts is exhausted.  
 \*Watts, speed, and air delivery may vary 10 per cent from figures given.  
 †For method of measuring air delivery see page 1171.  
 ‡For terms of delivery see page 1178.  
 \*\*These fans have series motors.

Order by Style Number



## GYRATING FANS



FLOOR COLUMN TYPE  
GYRATING

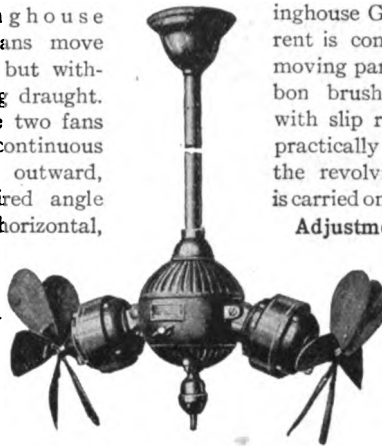
Westinghouse Gyrating Fans move all the air but without a strong draught. Each of the two fans produces a continuous flow of air outward, at any desired angle from the horizontal, and the direction of the flow is continuously gyrating about the central axis. The diverging current from the fans sweeps about so that at any point the air feels fresh and cool.

All the patrons receive the benefit, not only the fortunate ones who can secure places near the fan. The gyrating fans have a wind sweep of 20 to 25 feet and can be

spaced that far apart with excellent results.

**Construction**—The fans used on the gyrators are Westinghouse 12-inch fans with drawn-steel frames. Special bearings are provided that absolutely prevent the escape of oil. No guards are necessary.

**Gyrating Mechanism**—One of the fan motors is geared to a mechanical drive operating on a stationary central pulley. The drive is therefore positive and does not vary with the air reaction. The mechanism does not slow down, and cannot revolve at excessive speed—an exclusive feature of West-



inghouse Gyrators. Current is conducted to the moving part by two carbon brushes in contact with slip rings. There is practically no friction in the revolving part, as it is carried on a ball-bearing.

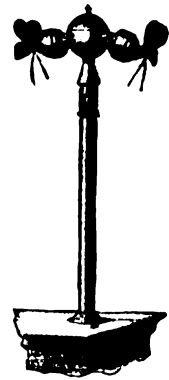
**Adjustment**—Breeze at any angle desired, from horizontal to 35 degrees below horizontal, can be had, by a positive

wing-nut adjustment at the side of the gyrating body. Turning this wing-nut raises or lowers the angle of both fans simultaneously. There is no possibility of tilting one fan more than the other and thus deranging the balance. The fans revolve about seven times a minute. Gyrating at higher speeds than this, the fans would tend to churn the air, restricting the distribution.

**Ceiling Type**—Ceiling type gyrating fans should be so mounted that, with the fans tilted to their limit, the lowest point of the blades is  $7\frac{1}{2}$  feet from the floor. Standard fans, including hanger rod, measure 55 inches from ceiling to lowest point of blades, suitable for 12-foot ceilings. Where ceilings are higher additional length of hanger rod should be ordered. The convenient pull switch on these fans can be operated from the floor.

**Finish**—Standard finish of all gyrating fans is dull black for all parts.

**Style number and price** include fan complete with suspension details as listed on another page.



COUNTER COLUMN  
TYPE GYRATING

### PRICES

Frequency Cycles	Volts	Watts*	Average rpm.*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS.		Style No.	Net Retail Price‡
					Net	Boxed		
60	100-120	88	1050	1700	48 1/2	103 1/2	221499	\$65 00
50	100-120	74	925	1500	48 1/2	103 1/2	221497	65 00
40	110-125	84	1075	1750	48 1/2	103 1/2	221495	68 00
25-30	100-125	76	1050	1700	48 1/2	103 1/2	221493	68 00
D-C.	100-125	64	1050	1700	46	101	221491	65 00

**220-Volt Fans** { For 220-Volt a-c. fans add \$3.00 to retail prices given above. } For 220-Volt d-c. fans add \$3.00 to retail prices given above. 220-Volt fans are not usually carried in stock.

Guards will be furnished, if desired, at an added cost of \$2.50 net per fan.

\*Watts, speed and air delivery may vary 10 per cent from figures given.

†For method of measuring air delivery see page 1171.

‡For terms of delivery see page 1178.

Order by Style Number

## 32-INCH AND 56-INCH CEILING FANS

The 56-inch ceiling fans are for use in large rooms, such as theatres, restaurants, large offices and stores.

The 32-inch ceiling fans are for use in doorways, narrow hallways, and small rooms or over display counters.

**Distinctive Features**—Westinghouse ceiling fans move a large volume of air with very small current consumption. They operate quietly and require little attention. Their construction is simple and their appearance handsome.

**Direction of Air Flow**—Standard fans throw the air downward, but if desired, the blades can be arranged to draw the air upward (reverse air flow), a desirable arrangement in places where the fan might disturb papers, as in offices and banks. Fans arranged for reverse air flow are not carried in stock, but are supplied on special order without extra charge.

**Finishes**—The standard finish is black enamel. Special finishes can be supplied at an advance in price, and subject to approximately fifteen days additional time for delivery.

**Construction**—Alternating-current motors are of the induction type; direct-current motors are series-wound.

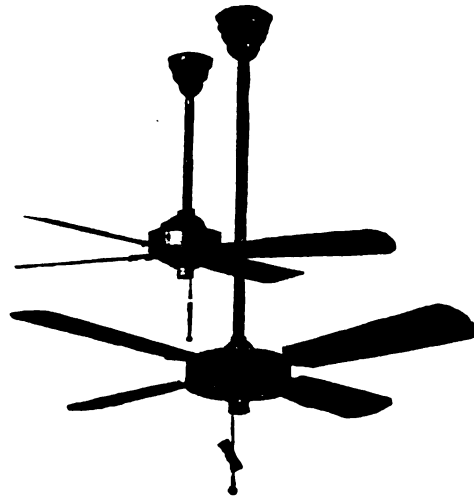
Alternating-current motors have external rotors which results in neater outlines, simpler construction and lighter weight, as compared with motors with internal rotors. The speed-control coils are placed inside the motor or in projections above or below the motor.

Ball bearings are used in the alternating-current motors. The balls are held in retainers, which keep them properly spaced, prevent noise, and hold them together in case the motor must be dismantled. The ball-race consists of two hardened steel plates between which the balls roll. The shafts of all motors are of hardened steel, and with proper care will give long service without appreciable wear.

The direct-current fans have a combination fibre and tool-steel thrust bearing immersed in oil. The

low current consumption of these fans proves the small amount of friction in this bearing.

The lubricating system of the motors deserves special mention. Oil is poured in through an oil hole at the top of the motor and runs into a reservoir around the bearings. The bearings are, there-



fore, immersed in oil. When the motor is in operation the oil is pumped upward along the shaft by means of a spiral groove on the shaft and flows back into the reservoir again. By this means a circulation of the lubricant is assured and one oiling suffices for the season.

**Blades**—Each fan has four blades. Two-bladed fans are not recommended by Westinghouse because of their small output. The blades are of wood with mahogany finish on the 56 in. and are of rust resisting metal on the 32 in.

**Style number and price** include fan complete with suspension details noted on page 1171.

### PRICES

Frequency Cycles	Volts	Watts at High Speed*	Average rpm.*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS.		Style No.	Net Retail Price‡
					Net	Boxed		
60	100-115	150	225, 160	7500	52	100	115725	\$52 00
50	100-115	160	225, 160	7500	52	100	164300	55 00
40	100-115	170	195, 160	6500	52	100	115739	58 00
25-30	100-115	155	225, 165	7500	52	100	115727	58 00
D-C.	100-125	110	225, 160, 100	7500	52	100	198122	52 00
D-C.	27- 32	110	225, 160, 100	7500	52	100	293368	52 00

#### 32-Inch 4-Blade Ceiling

60	100-120	70	440	3350	22	45	164948	40 00
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**220-Volt Fans**—For 220-volt a-c. fans add \$1.50 to the retail prices given above. For 220-volt d-c. fans add \$1.50 to the retail prices given above. 220-volt fans are not usually carried in stock.

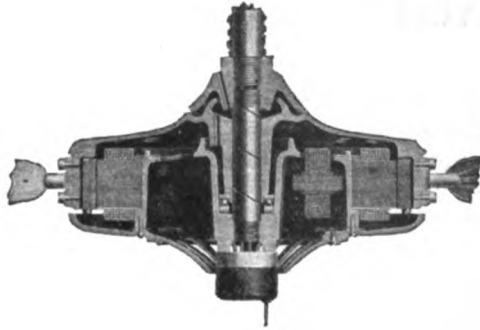
\*Watts, speed and air delivery may vary 10 per cent from figures given.

†For method of measuring air delivery see page 1171.

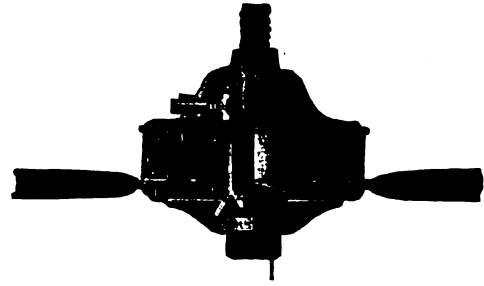
‡For terms of delivery, see page 1178.

*Order by Style Number*

## CEILING FANS—Continued



CROSS SECTION—56-INCH A-C. FAN



CROSS SECTION—56-INCH D-C. FAN

## SUSPENSION DETAILS OF GYRATING AND CEILING FANS

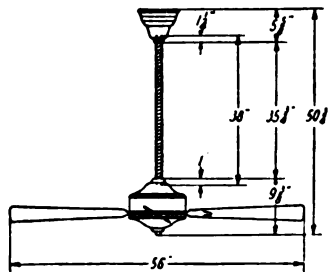
**Canopy, Hanger and Hook**—Every ceiling fan is furnished with a ceiling canopy, ceiling hook, and insulating hanger. The canopy is always finished to match the hanger rod of the fan.

**Gyrating Fans** are furnished with a 38-inch plain iron hanger pipe finished dull black, suitable for a 12-foot ceiling.

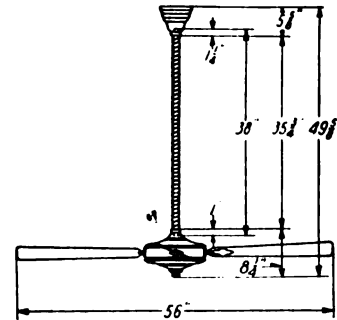
**Ceiling Fans** are shipped without any hanger rod. Ordinary black iron conduit is suitable for this

purpose; use  $\frac{3}{4}$ -inch. It can be supplied with fans at an addition of 20 cents retail per foot or fraction thereof.

If ceilings are higher than 12 feet, order extra length of hanger pipe and allow 40 cents retail per foot or fraction thereof for nickel plate or white enamel finish, and 20 cents retail per foot or fraction thereof for dull black finished hanger pipe.



DIMENSIONS OF D-C. CEILING FAN



DIMENSIONS OF A-C. CEILING FAN

## AIR DELIVERY OF ELECTRIC FANS

Air delivery provides a reliable method of comparing the effectiveness of different fans. The current consumed is of itself of little use in determining the efficiency of a fan, as a fan consuming more current may be more efficient—if it moves comparatively more air. For this reason the amount of air delivered by each fan listed is published in this catalogue. In comparing efficiencies it must be remembered that efficiency must be sacrificed to some extent to obtain distinct speed changes.

The figures for air delivery given in this catalogue include only the air passing through the fan, and are the result of tests made close to the fan. If tests are made at a distance, considerable entrained air is included, showing a much larger volume of moving air but at reduced velocity. Attention should be paid to this point in comparing the air deliveries of various fans. Westinghouse fans are tested as follows:

**Desk-and-Bracket Fans** — Measurements are made with a  $1\frac{1}{2}$ -inch target type anemometer placed six inches in front of the blades and at every inch across the diameter of the column of moving air, in four quadrants. The volume of moving air in each ring one inch wide is calculated from the average of the four readings and the various volumes added together.

**Gyrating Fans**—Same as desk-and-bracket fans.

**Ceiling Fans**—Measurements are made with a 4-inch moving vane anemometer placed two feet below the blades, and at every four to six inches across the diameter of the column of moving air, in four quadrants. Results are then summed up as in the case of desk-and-bracket fans.

**Exhaust Fans**—Tests are made as on the desk-and-bracket fans except with the fan blowing through a wall one foot thick, the hole in the wall being  $1\frac{1}{2}$  inches larger than the diameter of the blades.

## RAILWAY-COACH FANS



12-INCH FAN WITH SWITCH

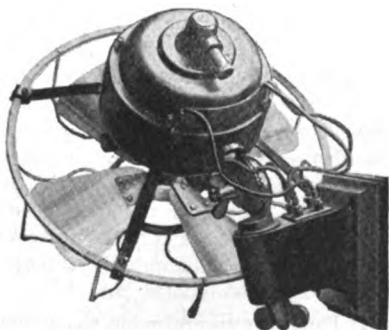
**Coach Fans** are used on private cars, sleepers, parlor cars, diners, and day coaches, where the railroad company realizes that to make the journey comfortable is the best way of pleasing its passengers and increasing travel over its lines.

Westinghouse railway coach fans embody all the excellent features of the standard Westinghouse fans. They differ from the standard fans in the details noted below.

**Voltage**—Two ratings of fans are listed: one that can be connected for operation on either 30 or 60 volts, the other for use on one voltage only. The change of connection for the 30 or 60-volt fans is simple. Fans for any special voltage can be furnished on special order.

### NON-OSCILLATING BRACKET FANS

A tooth joint with thumb-screw adjustment positively prevents the fan from tilting while the car is in motion. The fan can be readily removed from the bracket if desired.



VIEW OF THREE-SPEED NON-OSCILLATING FAN, SHOWING LOCATION OF RESISTOR AND CONNECTIONS TO BASE. TERMINALS ARE OF DIFFERENT SIZES TO PREVENT MISTAKES

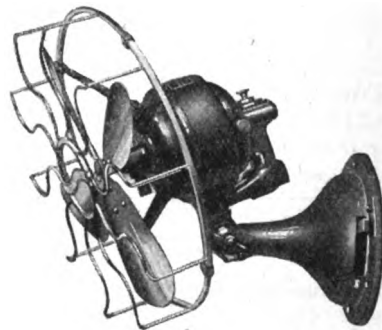
The three-speed fan has a small controlling resistor attached to the lower part of the motor shell, where it is not noticeable. Being heat treated, this resistor is not subject to deterioration due to exposure to the air, and will need no repairs. Two styles of fans are supplied; one without a switch and the other with a switch mounted directly on the base.

**Without Switch**—These fans are generally mounted on the sides or ends of the car, or in the smoking compartment and the lavatory. It is the usual practice to locate the control switch near the porter's cupboard, and for this reason the switch is not an integral part of these fans.

**With Switch**—These fans have a switch mounted on their base. They are used where it is desired to have the control switch at the same place as the fan.

### OSCILLATING BRACKET FANS

On the 30-60-volt fans the switch in the base serves as a terminal board for making connections either for 30-volt or 60-volt operation. A three-conductor cable carries the current from the switch to the motor body.



OSCILLATING BRACKET FAN

**Adjustments**—A special hinge joint permits the fan to be tilted either 10 or 20 degrees forward, the position being locked at these points by a pin operated by the wing nut and seating in drilled holes in the tilting part. The fan is thus positively prevented from tilting due to motion of the car.

### GYRATING CEILING FANS

The revolving carrier and lower casting containing the brushholders are attached to the ceiling casting by a combination joint, and a pin is provided in both ceiling casting and carrier, over which the hooked end of a rod may be placed, thus holding the fans for convenient inspection. Sufficient extra cable is supplied to allow the fans to be so lowered without disturbing the connections. This arrangement obviates the necessity of removing the ceiling casting from its permanent fastening.

RAILWAY-COACH FANS—Continued

RAILWAY EXHAUST FANS

Exhaust fans can be installed in either the ceiling or the sides of the car. Intake and exhaust pipes should be avoided; if such pipes are necessary, they should be short and straight.

**Lubrication**—The vital point in a vertical exhaust fan used in car roof is the provision for proper lubrication and this feature has been very carefully considered. After careful tests, self-lubricating bearings have been adopted, which require no oiling or other attention.



GYRATING CEILING FAN

ELECTRIC RAILWAY FANS

Direct-Current, 500-600 Volts

Any of the foregoing types of fans are furnished for use on electric railway cars, including subway,



VERTICAL EXHAUST FAN  
Requires Opening 13 1/2 INCHES

surface, elevated, and interurban, where 500 to 600 volts is the prevailing voltage. They are the standard railroad coach fans, without switch, wound for 300 volts and insulated for 600 volts. They have one lead grounded to prevent shock to any person coming in contact with the fan.

In operation two fans are connected in series. In the case of gyrating fans, the two motors of each fan are put in series. As all types of fans are insulated for 600 volts each, neither fan will burn out should one fail in service, as the remaining fan will merely run at double speed until discovered and turned off.

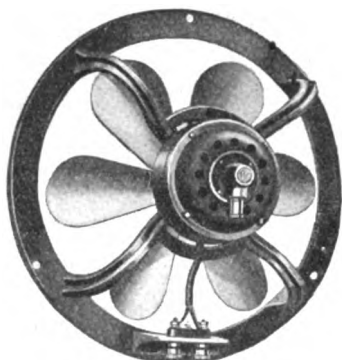
PRICES

Diameter of Blades Inches	Volts†	Watts at High Speed*	Approximate Speed rpm.*	Cu. Ft. of Air per Minute‡	APPROXIMATE WEIGHT, LBS. Net	Boxed	Style No.	Retail Price¶
<b>Stationary Bracket Fans</b>								
<b>Without Switch</b>								
9	30 or 60	25-45	(1) 1600	800	13	25	186025	\$25 60
12	30 or 60	25-45	(1) 1600	850	13	25	186026	27 60
9	30	26	(3) 1600, 1300, 1000	800	13	25	186027	28 50
12	30	26	(3) 1600, 1300, 1000	850	13	25	186028	28 50
12	550‡	32	(1) 1600	850	18	30	238579‡	29 25
<b>With Switch</b>								
9	30 or 60	25-45	(1) 1600	800	13 1/2	25 1/2	186029	27 25
12	30 or 60	25-45	(1) 1600	850	13 1/2	25 1/2	186030	29 25
9	30	26	(3) 1600, 1300, 1000	800	13 1/2	25 1/2	186031	30 50
12	30	26	(3) 1600, 1300, 1000	850	13 1/2	25 1/2	186032	30 50
<b>Oscillating Bracket Fans</b>								
12	30 or 60	30-45	(1) 1600	850	15	29	238209	31 50
12	30	30	(3) 1600, 1300, 1000	850	15	29	238211	32 00
<b>Gyrating Ceiling Fans</b>								
12	30 or 60	60-90	(1) 1050	1700	49	104	238058	61 50
<b>Exhaust Fans</b>								
<b>Vertical Delivery</b>								
12	30 or 60	30-45	(1) 1150 or 1190	800	17 1/2	28 1/2	270797	28 50
<b>Horizontal Delivery</b>								
12	30	25	1075	725	25	42	186033	26 75

\*Watts, speed and air delivery may vary 10 per cent from figures given.  
 †For method of figuring air delivery, see page 1171.  
 ‡These fans are designed to operate two in series on 500 to 600 volts. §Where only one fan is to be used on 500 to 600 volts, a resistor, Style No. 186470, list price, \$1.25, must be used to take up the extra voltage; in such case the fan and resistor consume 64 watts.  
 ¶For terms of delivery, see page 1178.

Order by Style Number

## EXHAUST FANS



12-INCH EXHAUST FAN

Westinghouse Electric Exhaust Fans are the most efficient means for removing foul air and odors from kitchens, lavatories, theatres, restaurants, school-rooms, and other places requiring ventilation.

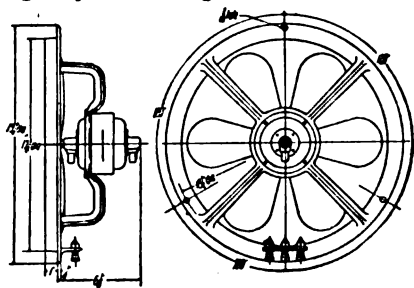
**Installation**—These fans should be mounted in walls or partitions. They should discharge directly into open spaces. Intake and exhaust pipes should be avoided; if such pipes are necessary they should be made as short and straight as possible.

**Blades**—The 25-30-cycle fans are supplied with four blades, and the 40, 50 and 60-cycle fans are supplied with six blades.

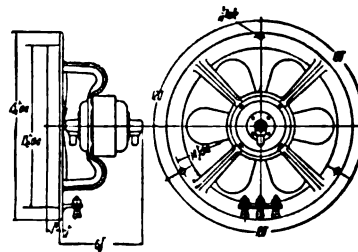
**Speed Regulator**—These motors are single-speed but a speed regulator can be supplied for the fans as listed below. The regulator is mounted separately from the fan at any convenient location. The regulator is operated by means of a lever.

**Finish**—The motor and frame are finished in black enamel. The blades are finished in dull black.

**Lubrication**—Self-lubricating bearings have been adopted for the vertical exhaust fans. These bearings require no oiling or other attention.



16-INCH FAN



12-INCH FAN

### PRICES

Frequency Cycles	Number of Blades	Volts	Watts at High Speed*	Average rpm.*	Cu. Ft. of Air per Minute†	APPROX. WT., LBS.		Style No.	Net Retail Price‡
						Net	Boxed		
<b>12-Inch Fans—Horizontal Delivery</b>									
60	6	100-120	42	1050	860	18	35	251415	\$30 00
50	6	100-120	46	900	725	18	35	251413	30 00
40	6	110-125	43	1000	840	18	35	251411	31 00
25-30	6	105-115	36	1050	850	16	33	251409	31 50
D-C.	6	100-115	32	1150	935	16	33	251407	30 00
<b>12-Inch Fans—Vertical Delivery</b>									
60	6	100-120	40	1070	720	18	35	270796	30 00
D-C.	6	100-120	32	1090	735	16	33	270795	30 00
<b>16-Inch Fans—Horizontal Delivery</b>									
60	6	100-120	93	1000	1665	25	47	251425	34 00
50	6	100-120	86	900	1480	25	47	251423	34 00
40	6	110-125	90	1000	1670	25	47	251421	35 00
25-30	6	105-115	70	1050	1725	22	44	251419	35 50
D-C.	6	100-115	63	1050	1725	22	44	251417	34 00
<b>16-Inch Fans—Vertical Delivery</b>									
60	6	100-120	90	1040	1500	25	47	270799	34 00
D-C.	6	100-120	62	1070	1530	22	44	270798	34 00

**220-Volt Fans**—For 220-volt a-c. fans add \$2.00 and for d-c. \$2.50 to retail prices given above. 220-volt fans are not usually carried in stock.

\*Watts, speed and air delivery may vary 10 per cent from figures given.

†For method of measuring air delivery see page 1171.

‡For terms of delivery, see page 1178.

### Speed Regulators for 110-Volt Exhaust Fans

Regulator Style No.	For Fan Style No.	Fan Speed	Additional Speeds with Regulator	Regulator Retail Price‡	Regulator Style No.	For Fan Style No.	Fan Speed	Additional Speeds with Regulator	Regulator Retail Price‡
251428	251407	1150	925-675	\$5 00	251442	251421	1000	900-800	\$5 00
251430	251409	1050	800-500	5 00	251444	251423	900	750-600	5 00
251432	251411	1000	850-700	5 00	251446	251425	1000	850-650	5 00
251434	251413	900	800-700	5 00	251428	270795	1150	925-675	5 00
251436	251415	1050	850-680	5 00	251436	270796	1050	850-680	5 00
251438	251417	1050	850-650	5 00	251438	270798	1050	850-650	5 00
251440	251419	1050	850-650	5 00	251446	270799	1050	850-650	5 00

Approximate net weight, 5 pounds; shipping 8 pounds.

Speed regulators for 220-volt fans are same price as 110-volt speed regulators.

‡For terms of delivery, see page 1178.

Order by Style Number

## DETAILS OF DESK-AND-BRACKET FANS

**Drawn-Steel Construction**—Base, motor body and motor end-brackets of drawn steel.\* This gives smooth and lustrous surface without joints, ridges, or rough spots.

**High Efficiency**—Note in the tables the small amount of power required as compared with the air delivery.

**Speeds**—Three distinct speeds. Motor will start on any speed.

**Substantial Control Switch**—Mounted on steel base plate; completely accessible on removing this plate. Switch lever does not open the circuit between points; firmly held at each point by notched metal guide.

**Felt Padded Base**—Fan rests on a felt pad backed by a steel plate, similar to a telephone base, preventing the marring of polished surfaces and affording mechanical protection to the switch. Felt clamped to bottom and edge of base by a steel ring inside base.

**Starting**—Fans have exceptionally high starting torque and will start in any position.

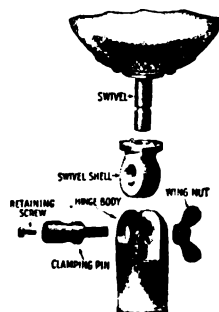
**Noiseless Construction**—Laminations riveted together and pressed into the frame, avoiding the possibility of vibration. Slots of induction motor rotors skewed to insure quiet operation.

**Hardened Steel Shafts**—Ground to size.

**Efficient Lubrication**—Grease cups with felt wicks passing through conical guides. Cups filled with vaseline and require attention only once a season. Grease cannot be thrown from bearings. Oil returns provided.

**Square Brushes**—(for series motors) to give greater contact surface and prevent turning.

**Strong Blades**—Made of heavy gauge metal, so shaped as to give maximum air delivery and minimum noise.



Parts  
SWIVEL-AND-HINGE JOINT OF NON-OSCILLATING FAN



Phantom View

\*Body of 10-inch oscillator is die cast integral with gear case.

**Substantial Guard**—So strong and rigid that it is recommended as the means for carrying the fan. Securely fastened to the motor body by pressed steel arms.

### On Non-Oscillating Fans

**Swivel-and-Hinge Joints**—12-inch and 16-inch fans can be tilted forward 15 degrees, backward 90 degrees, rotated 340 degrees, fastened by a wing nut. Smaller fans have simple hinge, no swivel.

**Brushholders** (of series motors)—Riveted inside of front bracket, permanently connected to the field leads—not disturbed in removing the armature.

### On Oscillating Fans

**Oscillating Mechanism**—Eight\* oscillations per minute over an arc of 90 degrees or 45 degrees. Mechanism geared to armature shaft. Worm wheel and worm can be replaced without tools. Oscillation can be stopped and started instantly while fan is running. If guard strikes an obstruction the fan stops oscillating but continues to operate without overturning or burning out the motor. This is due to automatic safety clutch.

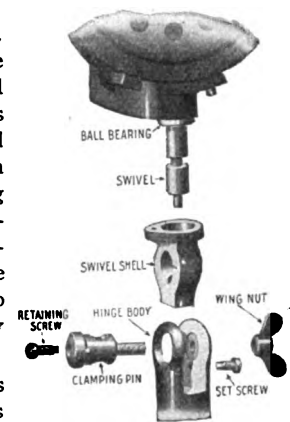
**Hinge Joint**—Fans can be tilted 20 degrees forward or backward in either desk or bracket position. Arranged for bracket mounting by removing a set screw, turning back to position and replacing set screws. When mounted in bracket position, fan should not be tilted farther forward than the set screw allows when fully inserted.

**Lubrication**—Oscillating mechanism is entirely enclosed and cannot drop oil if packed with proper lubricant. Motor shaft and oscillator crank shaft are both grooved spirally to return surplus lubricant to reservoir in top of case. For directions for oiling see page on Fan Motor Oil.

**Flexible Cable**—Special flexible cable carries current from the base to the motor body. The flexibility of this cable is important.

**Brushholders** (on series motors)—Riveted inside of rear bracket as position of oscillating mechanism makes it necessary to remove armature from the front. Permanently connected to the field leads.

**Removable Lead Cap** is provided to make repair of oscillating lead simple, should it break. Not necessary to dismantle motor to repair.



PARTS OF HINGE JOINT OF  
OSCILLATING FAN

## DETAILS OF DESK-AND-BRACKET FANS

### Cross-Section of the Oscillating Mechanism

To stop the fan from oscillating, pull this knob up.

When the knob is pulled up, the ball bearings are thrown out of the worm wheel into the recess and the fan is locked in the desired position.

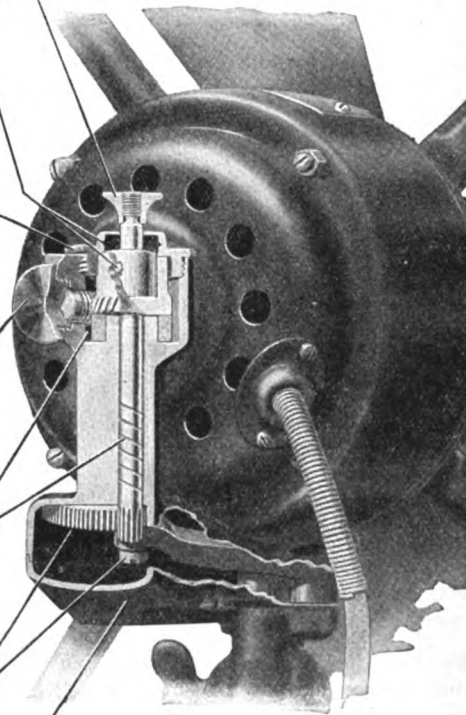
To grease the oscillator, unscrew the cap, and fill the cup with Westinghouse Fan Motor Grease— from this point the shaft, clutch and worm wheel are easily withdrawn as a unit.

The worm drive is separable from the motor shaft, and easily removed by unscrewing this cap.

Grease from the grease cup follows the shaft to the gearing at the bottom—surplus grease is pumped back by a spiral pump on the shaft.

To change the arc of oscillation from 90° to 45°, move this screw to the other hole in the gear.

If excess grease is forced down the main shaft, it is caught in the drip pan—no oil or grease can drip from Westinghouse Oscillating Fans.

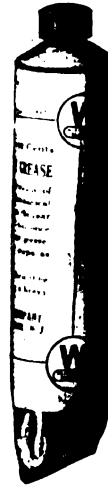




# WESTINGHOUSE FAN-MOTOR OIL AND GREASE



WESTINGHOUSE  
FAN-MOTOR OIL



WESTINGHOUSE  
FAN-MOTOR GREASE

## FAN-MOTOR OIL

**Use**—Westinghouse fan-motor oil is intended for fan motors, fractional horsepower motors, and all light machinery, where a light high-grade oil is required and will lubricate properly at a temperature as low as zero degrees Fahrenheit.

**Applying the Oil**—The motor bearings of desk and bracket fans should be re-oiled each season. Before re-oiling, all old grease should be removed, and the end of the wick, which may have become hardened from rubbing on the shaft, should be trimmed off. After filling the oil cups, they should be screwed tightly into the bearings, so that the oil from the return ducts will not leak through the threads. When oiling ceiling fans, only one-half ounce (one tablespoonful) should be used after all the old oil has been removed. Exhaust fans, which

are run almost continuously, should be re-oiled every four to six months. **Do not attempt to oil exhaust fans that are equipped with self-lubricating bearings.**

## FAN-MOTOR GREASE

**Use**—Westinghouse fan-motor grease is intended for lubrication of the oscillating mechanism of mechanical-oscillating fans, and of gears, and other machinery requiring a heavy high-grade grease that does not become too thin in warm weather.

**Applying the Grease**—The gear case on the rear of the motor should be cleaned out once each season, and re-packed with new grease. **Do not use this grease in the oil cups as it will not feed through the wicks properly. Do not use vaseline as it becomes too thin in warm weather.**

## PRICES

Description	Quantity	Style No.	Net Retail Price
Westinghouse Fan-Motor Oil	$\frac{1}{4}$ pint can	248851	\$0 25
Westinghouse Fan-Motor Grease	1 ounce tube	247597	15

Order by Style Number

## TERMS OF DELIVERY

Prices on all standard fans, including Whirlwind 8-inch, are f.o.b. cars, Newark, N. J., or the following points if regularly in stock:

Atlanta, Ga.	Chicago, Ill.	Houston, Tex.	Omaha, Neb.
Baltimore, Md.	Cincinnati, O.	Jacksonville, Fla.	Philadelphia, Pa.
Birmingham, Ala.	Cleveland, O.	Kansas City, Kans.	Pittsburgh, Pa.
Boston, Mass.	Columbus, O.	Minneapolis, Minn.	St. Louis, Mo.
Buffalo, N. Y.	Columbia, S. C.	Memphis, Tenn.	St. Paul, Minn.
Charleston, W. Va.	Dallas, Tex.	New Orleans, La.	Tampa, Fla.
Charlotte, N. C.	Detroit, Mich.	New York, N. Y.	

On shipments of 500 pounds or more of standard fans from the factory at Newark, N. J., to any destination, freight will be equalized with the f.o.b. point nearest to destination. There will be no allowance or equalization on express shipments regardless of weight.

When fans are purchased f.o.b. cars at the point named below, 3% must be added to the retail prices as established for each fan. This addition to be made to the published retail price before any discount is taken to obtain net price.

Denver                      El Paso                      San Antonio                      Ft. Worth

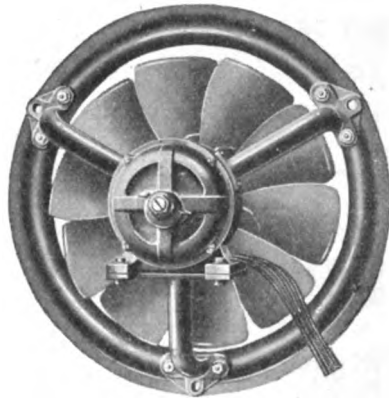
When fans are purchased f.o.b. cars at the points named below, 5% must be added to the retail price established for each fan. This addition to be made to the published retail price before any discount is taken to obtain net price.

Salt Lake City                      San Francisco                      Los Angeles  
Butte                      Seattle                      Portland



*Now Then!—*

# WESTINGHOUSE VENTILATING FANS



WESTINGHOUSE VENTILATING FAN SHOWING ALTERNATING-CURRENT MOTOR

Westinghouse Ventilating fans are designed for ventilating, cooling, and exhaust service, and are especially suitable for use where the air passages to and from the fan are open and unobstructed. These fans are quiet running, very efficient in operation, simple to install, and can be operated from the lighting circuit.

They can be used to advantage in almost every building and manufacturing plant, especially the following:

- |                         |                                    |
|-------------------------|------------------------------------|
| Hotels                  | Laundries                          |
| Restaurants             | Printing plants                    |
| Public buildings        | Garages                            |
| Theatres                | Residences                         |
| Moving picture theatres | Factories                          |
| Offices                 | Stores                             |
| Natatoriums             | Foundries                          |
| Bakeries                | Paint shops                        |
| Paper mills             | Chemical works                     |
| Rubber factories        | Laboratories                       |
| Dye houses              | Cleaning and dyeing establishments |

They are used for ventilating and cooling:  
 Kitchens                      Smoking rooms  
 Lavatories                      Workrooms  
 Engine rooms                      Halls  
 and for removing:  
 Smoke              Foul air              Dust              Gases  
 Steam              Hot air              Odors

## Construction

The fan consists of four main parts: the fan wheel, ring, arms, and motor. The wheel is mounted on the motor shaft; the motor is supported by three arms which are attached to the ring.

The fan wheel is made up of ten steel blades securely riveted to a large central disc. It is light in weight and perfectly balanced so that operation without vibration is assured.

The ring is a substantial iron casting. Holes are provided for mounting bolts.

The arms are bolted to the ring and to the motor and form a rigid support for the motor.

The motor—Westinghouse single-phase or poly-phase motors similar in construction to CA and CSA motors are furnished for alternating-current circuits. Series-wound motors similar in construction to CD motors are furnished for direct-current circuits. These motors are especially designed for this service and are totally enclosed so as to be protected from dust, dirt and moisture. A thrust bearing takes up the backward thrust caused by the fan wheel.

## Starting and Control

A simple snap or knife switch is the only starting device required. For direct-current fans, a small speed-regulating rheostat can be furnished which permits of six speeds from full speed to 50 per cent of full speed.

## RATINGS AND STYLE NUMBERS

### Alternating-Current

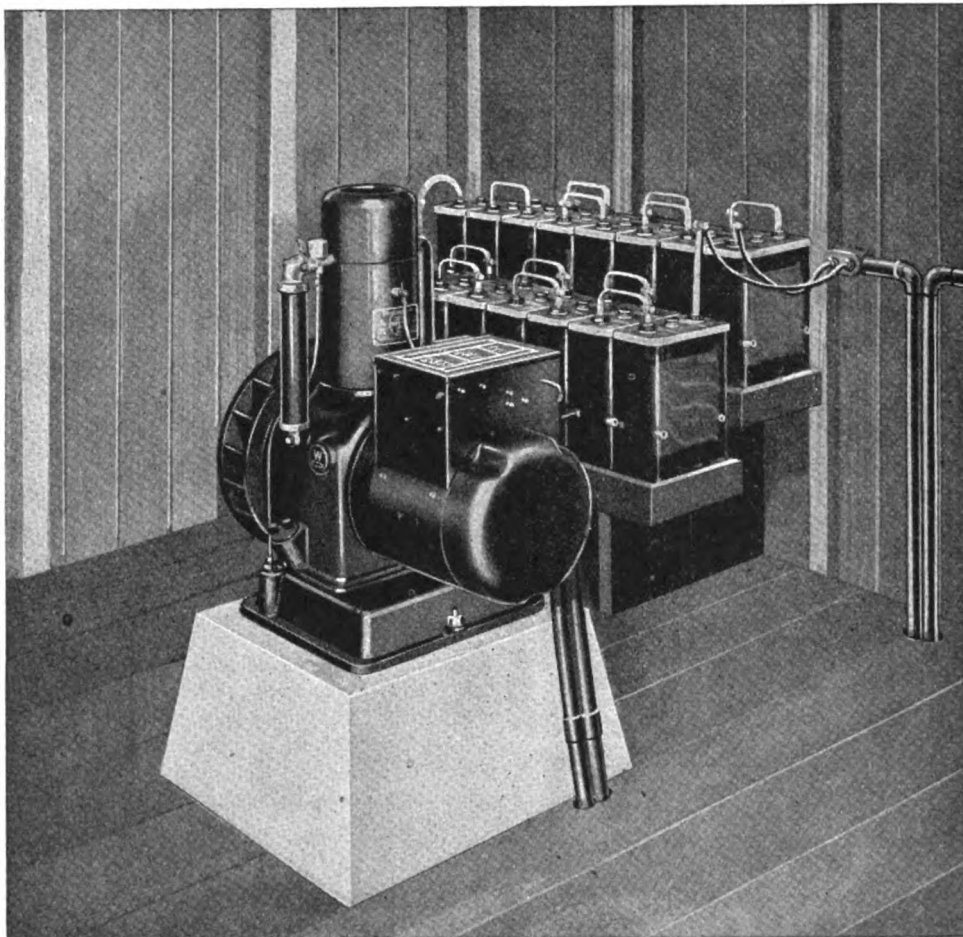
No. of Fan	Wheel Diam.	H.P.	Approx. R.P.M.	Capacity in Cu. Ft. Per Min.	SINGLE-PHASE		TWO-PHASE		THREE-PHASE		Approx. Shipping Wt. Lbs.
					110-Volt Style No.	220-Volt Style No.	110-Volt Style No.	220-Volt Style No.	110-Volt Style No.	220-Volt Style No.	
3 1/2	18 3/4	.085	870	1860	187345	187346	224904	224905	224906	224907	130
4	21 1/4	.11	880	2770	187347	187348	224908	224909	224910	224911	160
5	26 3/4	.17	700	4420	187349	187350	224912	224913	224914	224915	215
6	32	.26	575	6530	187351	187352	224916	224917	224918	224919	285
7	37 1/4	.42	565	9830	246318	246319	246320	246321	246322	246324	365

### Direct-Current

No. of Fan	Wheel Diam.	H.P.	Approx. R.P.M.	Capacity in Cu. Ft. Per Min.	SERIES-WOUND D.C. FANS				Approx. Shipping Wt. Lbs.	
					STYLE NO. OUTFIT WITHOUT RHEOSTAT		STYLE NO. RHEOSTAT			
					115-Volt	230-Volt	115-Volt	230-Volt		
3 1/2	18 3/4	.085	870	1860	187353	187354	188588	188589	130	
4	21 1/4	.11	880	2770	187355	187356	188588	188589	160	
5	26 3/4	.17	700	4420	187357	187358	188590	188591	215	
6	32	.26	575	6530	187359	187360	188590	188591	325	
7	37 1/4	.42	565	9830	246327	244328	252512	252513	365	

Outfits complete consist of fan wheel, ring and motor with attaching arms. In ordering, always give style number.

## WESTINGHOUSE LIGHT AND POWER PLANTS



A LIGHT AND POWER PLANT INSTALLATION—TYPE E-30

The Westinghouse Light and Power Plants are self contained engine generator units with storage batteries. They are made in two sizes, the smaller being of 750 watts generator capacity with a 4500 watt hour battery and the larger is of 1500 watts generator capacity with either a 4500 or 6000 watt-hour battery. The large plant has a power pulley capable of delivering 3 h. p. to a belt.

These plants are used wherever central-station service is not available and where the load is not more than  $1\frac{1}{4}$  kilowatt for the smaller or  $2\frac{1}{4}$  kilowatt for the larger. However, several plants may be operated in parallel where more electrical energy is required.

The following is a partial list of places where these plants are being used:

- Farms, Ranches, Plantations, Groves.
- Suburban Homes and Estates.
- Country Stores, Garages, Motion Picture Theatres.
- Cross Roads Communities.

Boats, Ships, Wharves.

Construction Camps, Lumber Camps, Quarries, Mines.

Country School Houses and Churches.

Country Hotels and Boarding Houses.

Traveling Entertainments.

Hunting Clubs, Lodges, Camps, Summer Cottages.

On farms these plants provide safe, convenient and bright light as a substitute for kerosene lamps or acetylene systems. Fresh water direct from the well under pressure is made possible by the automatic electric motor-driven pump. The electric iron is a big convenience to the farm wife who does not have a gas stove, especially in summer, the washing machine, churn, separator, and milker can be motor driven to save much time and back-breaking work. Heating devices such as the warming pad, toaster, and percolator make farm life more pleasant. The farm appreciates electricity because the uses for it are so much greater than in the city and substitutes much poorer.

WESTINGHOUSE LIGHT AND POWER PLANTS—Continued

In all other places where these plants are used, electric light, fresh water under pressure, and motors for driving devices, heating appliances and

fans make possible the conveniences, comforts, and efficiency to be found in localities supplied with central station service.

SPECIFICATIONS

	E-30 (750 watt)	E-60 (1500 watt)
Service.....	32 volt.....	32 volt.....
Generator Capacity.....	750 watts.....	1500 watts.....
Engine Capacity.....	1½ h. p.....	3 h. p.....
Battery Capacity (at 8 hr. rate).....	4500 watt hours.....	4500 or 6000 wt. hr (optional)
Type.....	Unit type air-cooled.....	Unit type air-cooled.....
Operation.....	Semi-Automatic.....	Semi-Automatic.....
Starting.....	From battery by switch.....	From battery by switch.....
Stopping.....	Automatic.....	Automatic.....
Fuel.....	Gasoline, Kerosene, Natural Gas.....	Gasoline, Kerosene, Natural Gas.....
Speed.....	1250 R. P. M.....	1200 R. P. M.....
Mechanical Power.....	None.....	3 inch by 5 inch flywheel pulley.....
Regulator.....	Battery.....	Mechanical speed governor.....
Cylinder (single vertical).....	2½ inch by 4 inches.....	3¾ inch by 5 inches.....
Valves in head.....	Poppet type.....	Poppet Type.....
Cycles.....	4.....	4.....
Oil System.....	Constant Level Splash.....	Constant level splash.....
Battery (lead acid).....	16 cells.....	16 cells.....
Dimensions of Engine Generator.....	L25¾, W16¾, H29¾.....	L29¾, W20, H35¼.....

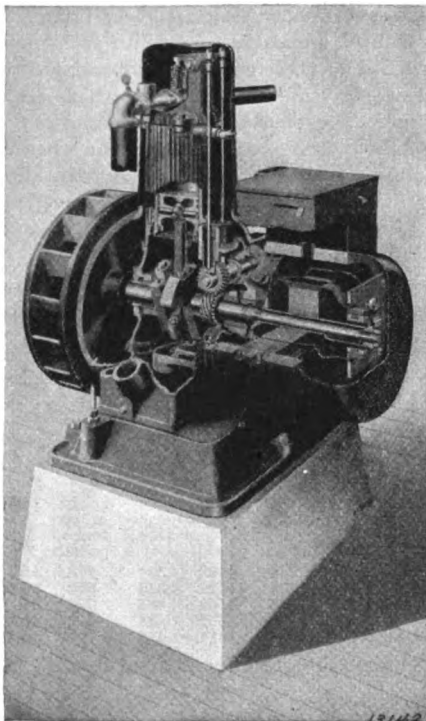
These plants may be installed in a cellar, in an outbuilding or wherever an exhaust line can be carried to the outside from the engine. There is no objectionable vibration, noise or odor. The National Board of Fire Underwriters has given unqualified endorsement to our plants, as not constituting a fire hazard.

Being air cooled, the plant may safely be installed even where a water cooled plant would be subjected to damage from freezing. Being semi-automatic, it is only necessary to press a lever to start the plant. When the battery is fully charged or when the task for which the engine is running is completed, the unit automatically stops itself. Being 32 volts it is necessary to have but 16 cells

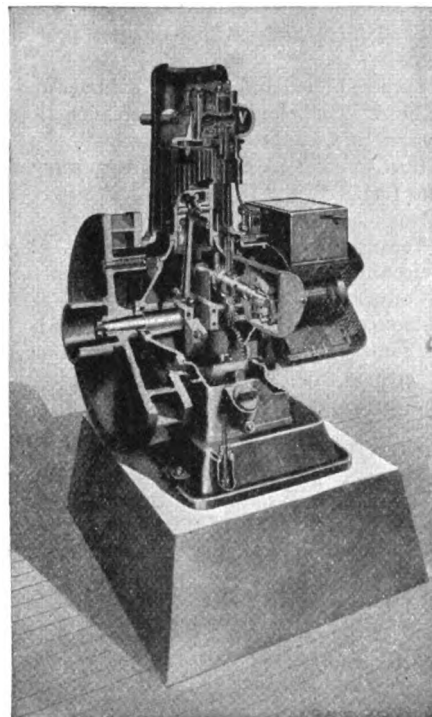
in the battery instead of 56 at 3½ times the cost as in a 110 volt plant. Storage batteries are necessary to care for small energy consumption when it is inefficient or inconvenient to run the plant, or when for some reason the plant is temporarily out of operation.

But one quart of kerosene or gasoline or 33 cubic feet of natural gas in either plant is required to generate 1 kilowatt hour of electricity. One quart of oil will last twenty-four hours of continual running. These results are what may be expected in service after the plant has been operating some time. They are not laboratory test results.

The Westinghouse Plants embody many improvements over other plants for similiar purposes.

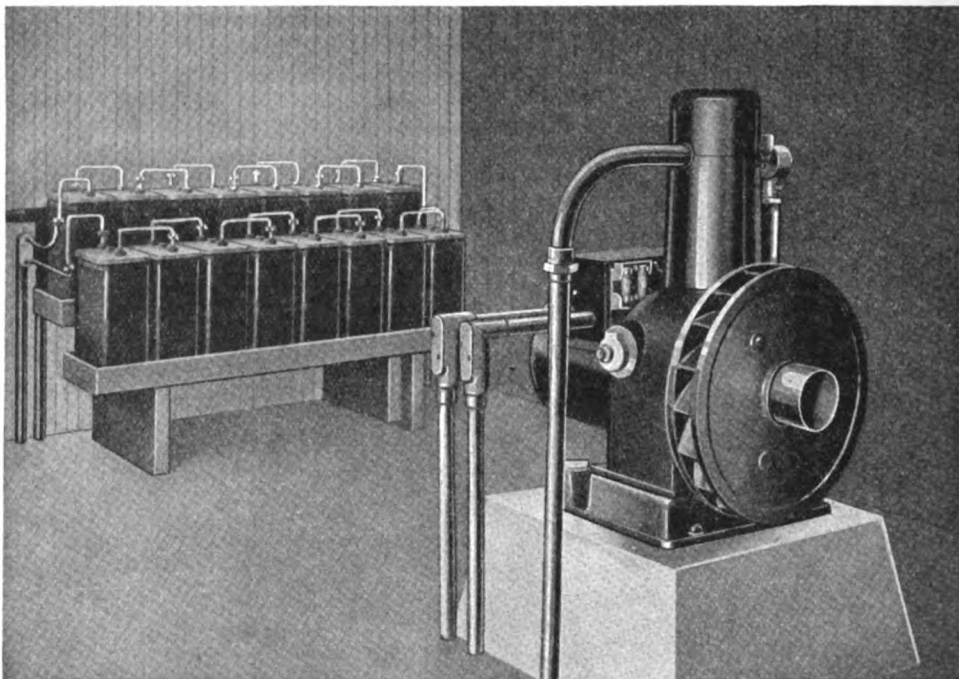


TYPE E-30 UNIT



TYPE E-60 UNIT

## WESTINGHOUSE LIGHT AND POWER PLANTS—Continued



TYPICAL INSTALLATION TYPE E-60 LIGHT AND POWER PLANT

These improvements have been incorporated after long and careful tests in the field under actual operating conditions. Some of them are:

1. Constant level splash oiling system which maintains even lubrication of all bearings regardless of the level of oil in the crankcase.
2. Steel fin cylinder which insures proper air cooling.
3. Combustion chamber in the cylinder and not in the head. This eliminates compression troubles and insures best engine performance.
4. Fuel tank in base provides safe, convenient store for fuel.
5. One place to oil.
6. Venturi mixer eliminates carburetor. A simple device that can not get out of adjustment.
7. Control box contains all electrical connections. No parts carrying current are exposed.
8. Shunt generator acts as compound motor to crank engine, with large torque requiring small amount of current from battery.
9. Hydrometer is calibrated to indicate hours the plant must run to charge the battery. A dial on the camshaft stops the plant at the proper time.

With each plant is shipped a complete set of tools for making adjustments, a hydrometer, thermometer, muffler, exhaust disk, priming can and gallon of lubricating oil. With each plant is also shipped a complete instruction book, and to all operating parts are attached tags which describe their use. The plant and batteries are shipped completely assembled and ready to run when filled with oil and fuel. No water is required. For operating on natural gas a small attachment is provided which does not interfere with operation at a later date on liquid fuel.

For moving installations such as traveling shows, boats, trains, and the like, a rubber jar battery can be supplied instead of the glass jar battery.

For domestic shipment the unit and tools are packed in one crate and the battery in four crates.

Style No. of Plant complete	Generator rating in watts	Battery rating in watt hrs. (8 hr. rate)	Glass or Rubber Jars	Dimension of engine generator crate inches	Weight of engine generator crate pounds	Dimension of each battery box inches	Weight of each battery box pounds	Total Gross Weight Shipment pounds	Net Weight of engine generator or pounds	Net Weight of batteries pounds	Style No. of battery only
359187	750	4500	glass	31½x36½x23½	431	35¼x22¼x16¾	258	1463	338	778	354881
359188	750	4500	rubber	31½x36½x23½	431	31½x13½x24¼	198	1223	338	600	354882
359504	1500	4500	glass	38x27x42	630	35½x22¼x16¾	258	1662	485	778	354881
359505	1500	4500	rubber	38x27x42	630	31½x13½x24¼	198	1422	485	600	354882
359506	1500	6000	glass	38x27x42	630	35¼x18¼x22¼	296	1814	485	904	354883

Batteries can be supplied separately, for voltages of 2 volts up to 110 volts or more.

Order by Style Number

## WESTINGHOUSE LIGHT AND POWER PLANTS—Continued

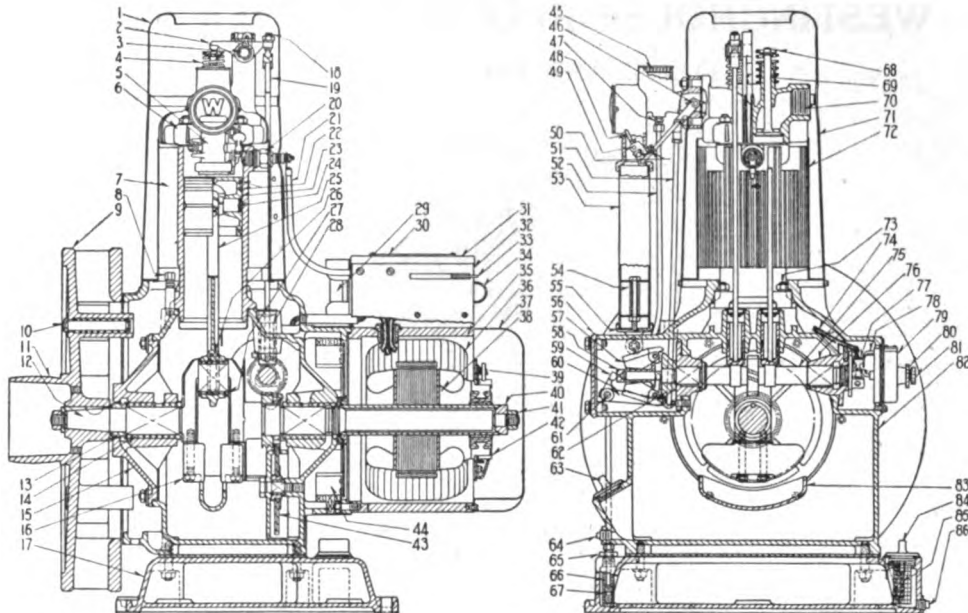


TABLE OF PARTS SHOWN IN CROSS SECTION VIEW OF TYPE E-30 PLANT

1. Cylinder Dome	30. Instruction Plate	59. Governor Arm (Short)
2. Rocker Arm	31. Control Box Cover	60. Governor Arm (Long)
3. Rocker Arm Pins	32. Control Box	61. Governor Shaft
4. Valve Spring	33. Starting Switch Handle	62. Governor Bracket
5. Venturi Mixer	34. Line Switch Handle	63. Oil Filling Plug
6. Cylinder Head	35. Generator Frame	64. Oil Drain Plug
7. Cast-in-Steel-Fin Cylinder	36. Field Coils	65. Fuel Pipe Tank Bushing
8. Crankcase Breather	37. Generator End Cover	66. Lower Fuel Strainer
9. Flywheel	38. Armature	67. Fuel Pipe Check Valve
10. Cranking Handle	39. Brush Holder	68. Valve Spring Washer
11. Power Pulley	40. Armature Conical Bushing	69. Poppet Valve
12. Crank Shaft	41. Armature Nut	70. Exhaust Port
13. Oil Thrower	42. Generator Brush	71. Cylinder Jacket (Outer)
14. Steel Back Babbitt Bearing	43. Oil Carrying Gear	72. Cylinder Jacket (Inner)
15. Crankcase End Cover	44. Armature Pan	73. Crankcase Cylinder Studs
16. Counter Weights	45. Priming Cup Strainer	74. Interrupter Lead
17. Fuel Base	46. Throttle Valve	75. Cam Shaft
18. Rocker Arm Adjusting Screw	47. Fuel Strainer and Coupling	76. Cam Shaft Bearing
19. Push Rods	48. Choke Lever	77. Interrupter
20. Spark Plug	49. Air Throttle Valve	78. Battery Meter Spring Contact
21. Spark Plug Wire	50. Air Throttle Adjusting Screw	79. Battery Meter
22. Piston Ring	51. Vertical Governor Rod	80. Battery Meter Lock Nut
23. Piston	52. Fuel Pipe	81. Battery Meter Setting Nut
24. Piston Pin	53. Air Silencer Tube	82. Crankcase
25. Connecting Rod	54. Air Silencer	83. Constant Level Oil Pan
26. Connecting Rod Bearing Bolt	55. Air Pipe Support	84. Fuel Filling Plug
27. Connecting Rod Bearing Cap	56. Governor Cover	85. Safety Chain
28. Tappets	57. Governor Flyball	86. Fuel Drain Plug
29. Fuses	58. Governor Sleeve	

## EXPORT SHIPMENTS

For shipments outside of the United States special packing is provided for sea shipment and for mule back transportation. Instructions are in either English, Spanish or Portuguese and all measurements in either the metric or English system. Batteries are shipped disassembled and provision is made for easy assembly. Carboys of electrolyte can be supplied on request. Extra parts for the battery and the plant are shipped to provide

against emergencies in shipment or operation. Publicity literature is available in English, Spanish and Portuguese.

We have very carefully provided all equipment, packing, instructions and other requirements to make our plants as satisfactory an investment to purchasers outside of the United States as they are to people at home.

## WESTINGHOUSE ELECTRIC POWER STAND

FOR 32 AND 110-VOLT SYSTEMS



The Westinghouse Electric Power Stand consists of a  $\frac{1}{4}$ -h.p. motor mounted on a tripod base to make it portable. It is intended for driving washing machines, pumps, churns, separators, grindstones, and other devices used in the farm household, dairy, barn, garage and out-buildings which require up to  $\frac{1}{4}$  h. p., and which have previously been turned by hand or a small gas engine. This device enables farmers and others to get the maximum usefulness from their lighting current by obtaining power as well as light.

The motor is built for 32 or 110-volt service, is compound wound and has two shafts. The main shaft or armature shaft turns at 2100 and 1725 r. p. m. respectively. To this shaft is geared a small shaft, also inside the motor frame, at an  $8\frac{1}{2}$  to 1 ratio, giving this low speed shaft a speed of 250 r. p. m. for the 32-volt and 210 r. p. m. for the 110-volt stand.

Two pulleys are provided on each shaft to give the speed required for driving the various devices. A  $6\frac{5}{8}$ -inch flat-faced pulley and a  $2\frac{3}{4}$ -inch grooved pulley are permanently attached to the slow speed shaft. A  $1\frac{1}{2}$ -inch flat-faced pulley and a 2-inch grooved pulley are supplied for use on the high speed shaft. The flat-faced pulleys are designed for  $\frac{7}{8}$ -inch flat belts, and the grooved pulleys for  $\frac{3}{8}$ -inch round belts.

Flat-faced pulleys are provided because the torque of the slow speed motors cannot be transmitted as well with a round belt as with a flat belt. A slow speed grooved pulley for round belt is supplied for use where the power requirements are not so great. Flanges are supplied on the flat-faced pulley so that the belt will not slip off if the two pulleys are not in exact alignment.

Provision is made for attaching an adjustable length rod for holding the motor rigid against the belt tension. The rod may be used either as a brace, or as a tie rod. The handle on top of the motor makes it easy to carry from one job to another. Weight complete is 57 pounds. Ten feet of reinforced two-conductor lamp cord with separable attachment plug is attached to the motor. The small power consumption enables this motor to be attached to any light socket.

The style number of the complete portable power stand for 32-volt service is 306887, and for 110-volt service, 310134. Either stand can be supplied with a standard sliding base for permanent mounting for bench work or for driving appliances. For the 32-volt motor the sliding base style number is 184554A, for the 110-volt motor, 184554. Approximate shipping weight is 75 pounds. The compactness and sturdy appearance of this motor make it an extremely attractive proposition for manufacturers of labor-saving devices going to the farm.

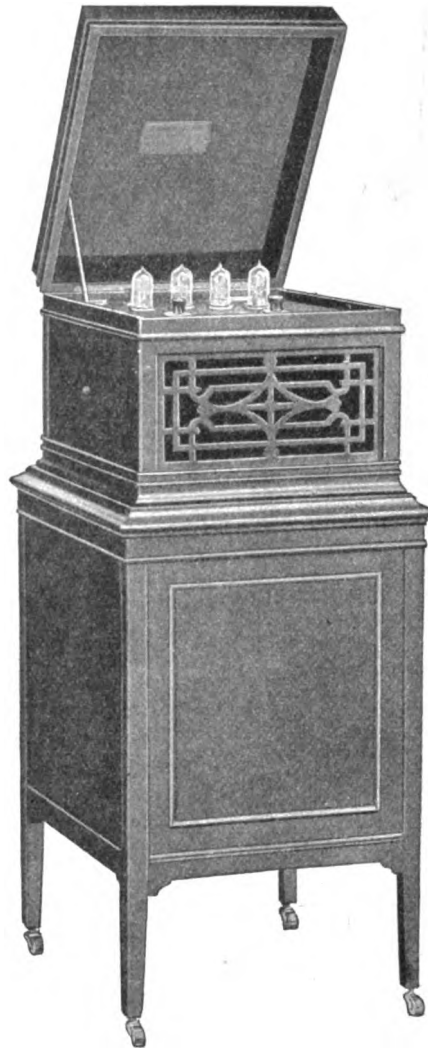
Below are a few of the many devices which can be driven by this portable power stand.

Water pumps	Bread mixers
Clothes washers	Coffee grinders
Cream separators	Meat grinders
Butter churns	Sewing machines
Grindstones	Sprayers
Fanning mills	Clover cutters
Food choppers	Corn shellers
Horse clippers	Emery wheels
Ice cream freezers	Feed mixers
Root cutters	Drills and grinders
Sausage grinders	Bottle washers
Dish washers	Milk cooling pumps, etc.



## WESTINGHOUSE RADIO APPARATUS

*For prices and additional information, or license restrictions on the use of the Radio apparatus described on this page, apply to the nearest sales office of the Radio Corporation of America—New York, Chicago, San Francisco.*



### RADIOLA GRAND

STYLE No. 365102

Radiola Grand is an ideal cabinet receiver adaptable for installation in homes of finest appointments. It comprises a tuning unit, vacuum tube detector with two stages of audio frequency amplification enclosed within a highly polished solid mahogany cabinet, and a loud speaking unit with concealed horn. Two tubes are used for the last amplifying stage giving good volume with practically no distortion.

Radiola Grand uses WD-11 vacuum tubes which are operated from dry batteries.

Radiola Grand Style No. 365102 as illustrated does not include stand.

A stand Style No. 325980 can be furnished, on which the Radiola Grand can be mounted. The "A" batteries may be placed in this stand, thus making the instrument a highly desirable self-contained device.

## WESTINGHOUSE RADIO APPARATUS—Continued

*For prices and additional information, or license restrictions on the use of the Radio apparatus described on this page, apply to the nearest sales office of the Radio Corporation of America—New York, Chicago, San Francisco.*



**AERIOLA SR.**  
STYLE No. 319564

Consists of a tuner employing the regenerative circuit and a vacuum tube detector. The mechanism is mounted on underside of a moulded Bakelite panel, and the equipment is contained within a highly polished solid mahogany cabinet. A cover protects the knobs, etc. in shipment and makes the outfit easily portable. The WD-11 vacuum tube used with this outfit requires but one standard dry battery for the operation of its filament and one B battery for the plate supply. The Aeriola Sr. will receive from broadcasting stations on wave-lengths up to 500 meters.

It tunes sharply and will be found to be free from objectionable local noises such as are found in many receivers on the market.



**AERIOLA SR. (AMPLIFIER)**  
STYLE No. 365112

The Aeriola Sr. Amplifier is an audio frequency amplifier designed specifically for use with Aeriola Sr. The parts are mounted on a moulded Bakelite panel contained within a highly polished solid mahogany cabinet of the same dimensions as Aeriola Senior.

Aeriola Sr. Amplifier utilizes two WD-11 vacuum tubes which may be operated from dry batteries.

Filament control jacks are employed so that only the vacuum tubes that are actually in use are supplied with filament current.

When used with Aeriola Sr., the amplifier will operate a loud speaking telephone receiver satisfactorily.



**WD-11 VACUUM TUBE**  
STYLE No. 319533

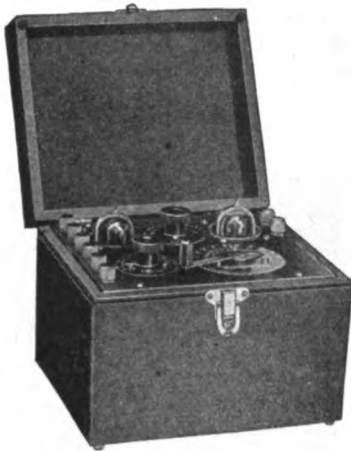
WD-11 vacuum tubes require no storage batteries. The filament operates from one standard  $1\frac{1}{2}$  volt dry battery consuming a current of 0.25 amperes. For detecting, a  $22\frac{1}{2}$  volt plate battery is sufficient. When used with audio frequency amplifiers, plate voltages from 45 to 80 may be used.

The tube owes its efficiency to its oxide coated platinum filament and to the care used in its design and manufacture. It gives practically no local noise found in some other types of tubes.

It is provided with a special base to fit Aeriola Sr. Amplifier, Radiola RS and Radiola Grand. It may be used in sets of home construction by utilizing WD socket S 365136 and may also be used in sets designed for storage battery tubes by employing WD adaptors S 365135.

## WESTINGHOUSE RADIO APPARATUS—Continued

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**RADIOLA RS**  
STYLE No. 358101

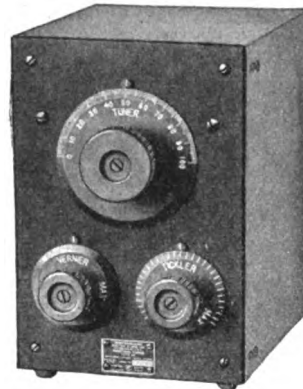
Radiola RS comprises a tuner, vacuum tube detector and one stage of audio frequency amplification, all mounted in a polished solid mahogany cabinet, the same size as that used with Aeriola Sr. All of the mechanism is mounted on a moulded bakelite panel.

Radiola RS will give good results with a loud speaking telephone receiver at short ranges and will give appreciable amplification of the received signal using a head set.

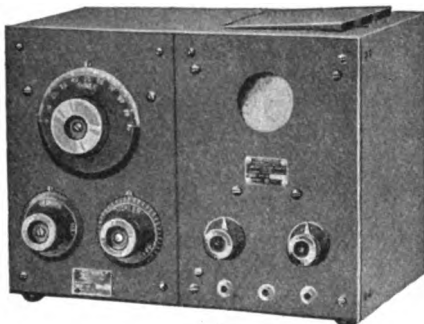
meters may be received with high selectivity and sensitivity.

This receiving set utilizes Radiotrons type UV 200 and UV 201, or, by using suitable socket adapters, WD-11 Radiotrons may be used. When WD-11 Radiotrons are used a storage battery will not be required as Standard No. 6 dry batteries will furnish sufficient power.

This set is so designed as to give minimum distortion when using a loud speaking receiver.

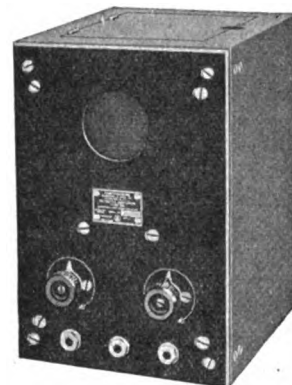


**RADIOLA RA**  
STYLE No. 307189



**RADIOLA RC**  
STYLE No. 307215

Radiola RC consists of a single circuit tuner and vacuum tube detector with two stages of audio frequency amplification. All of the mechanism is attached to the finely finished Micarta panels and is contained within a highly polished solid mahogany cabinet. Wavelengths ranging from 180 to 700

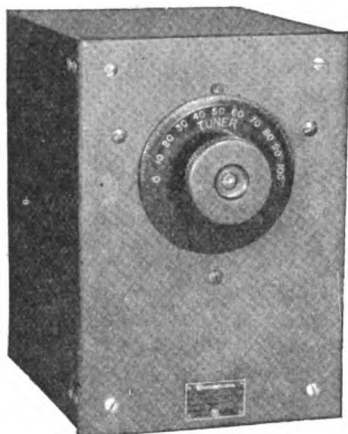


**RADIOLA DA**  
STYLE No. 307190

The mechanism contained in Radiola RC may also be had in the form of two separate units; namely, Radiola RA and DA. Other than being mounted in separate highly polished mahogany cabinets, these units are identical with Radiola RC.

## WESTINGHOUSE RADIO APPARATUS—Continued

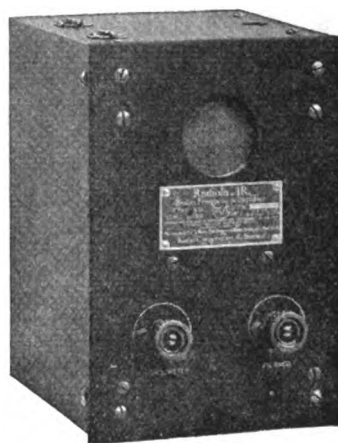
*For prices and additional information, or license restrictions on the use of the Radio apparatus described on this page, apply to the nearest sales office of the Radio Corporation of America—New York, Chicago, San Francisco.*



**RADIOLA RT**  
STYLE No. 359970

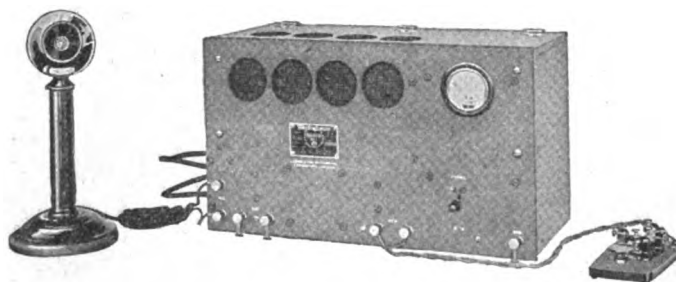
Those living in the immediate vicinity of broadcasting stations at times have difficulty in tuning out this station with Radiola RC or RA when it is desired to listen to more distant stations. To take care of this limited number, Radiola RT has been developed to increase the inherent selectivity of Radiola RC and RA. In operation Radiola RT is placed adjacent to either of these instruments and the antenna and ground connections are made to this unit. The energy is transferred inductively through the sides of the cabinet.

With the two cabinets close together, best results in most cases will be obtained. If greater selectivity is desired, Radiola RT can be moved further away with increase in selectivity.



**RADIOLA AR**  
STYLE No. 319518

Radiola AR is a radio frequency amplifier designed for use with Radiola RC or Radiola DA. It utilizes Radiotron UV-201 tubes. It may be used with loop receiver or on antenna.



**20 WATT TUBE TELEPHONE AND TELEGRAPH TRANSMITTER**

TYPE TF—STYLE No. 325996

The TF Transmitter is designed for short distance telephony, or continuous wave telegraphy over distances of from 10 to 150 miles.

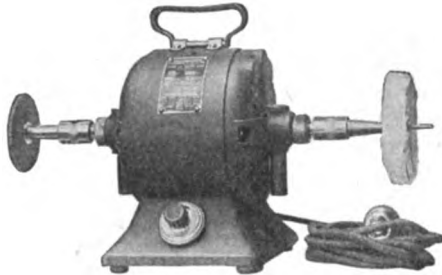
The complete Transmitter comprises a cabinet containing four 5 watt tubes with auxiliary equipment. A telephone microphone, telegraph key and motor generator set are also required. The standard motor generator set is designed for 110 volts, 60 cycles, single phase alternating current which cur-

rent is also fed through a step-down transformer to the vacuum tube filaments. A 6-volt battery is necessary for the microphone circuit and also for the telegraph relay.

On telephony the output is approximately 10 watts, utilizing two of the tubes as oscillators and two as modulators. For telegraphy, all four tubes are used as oscillators giving an output of about 20 watts.

# BUFFING, POLISHING AND GRINDING MOTORS

## ALTERNATING AND DIRECT-CURRENT



1/4 H.P. ALTERNATING-CURRENT BUFFING, POLISHING AND GRINDING MOTOR

Westinghouse buffing, polishing and grinding motors are suitable for light polishing and grinding of all kinds. They are used by jewelers, dentists and opticians for buffing and polishing, and for operating small tools by means of Ritter chucks; by machine shops and garages for buffing and light grinding, and by hotels, restaurants, and in the home for cleaning silver, polishing metalware, sharpening knives, tools, etc. With the addition of a flexible shaft the motor becomes a portable tool, and is convenient for cleaning and polishing decorative metal work, metal parts of automobiles, etc.

### Construction

The motor frame is a cylindrical iron casting. It is absolutely dust-proof and affords full protection to the interior parts.

The base is a hollow casting bolted to the frame and is of just the right height to allow the necessary clearance between the buffing wheel and motor support.

The shaft is extended at both ends for chucks which carry the buffing and grinding wheels.

A flexible shaft can be obtained from the Stow Manufacturing Company, Binghamton, N. Y. In ordering, specify rating of motor.

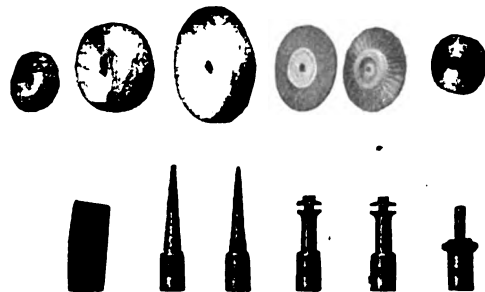
The bearings are bronze bushings pressed into housings in the bearing brackets. They are of the wick-fed, self-oiling type with ample provision against dripping. Machine oil or unmedicated vaseline is recommended as a lubricant.

**Speed**—The speed chosen is the most desirable single speed which eliminates the complications of multi-speed motors and results in a simpler, more rigid and less expensive motor.

**Finish**—Glossy black japan.

### Ordering

In ordering a buffing and grinding outfit give style number of motor and attachments. Connecting cord and plug are furnished with the motors. Table I gives the ratings and style numbers of the motors. Table II gives the list of attachments and style numbers.



ATTACHMENTS FOR THE MOTORS

### Ratings and Style Numbers

Table I—1/4 H.P. Direct and Alternating-Current Motors

**Alternating-Current, 60 Cycles, Single-Phase**

H.P.	Volts	Approx. Full Load R.P.M.	Style No. Motor Only
1/4	110	3500	273963
1/4	220	3500	273964

**Direct-Current**

1/4	115	2550	273965
1/4	230	2550	273966

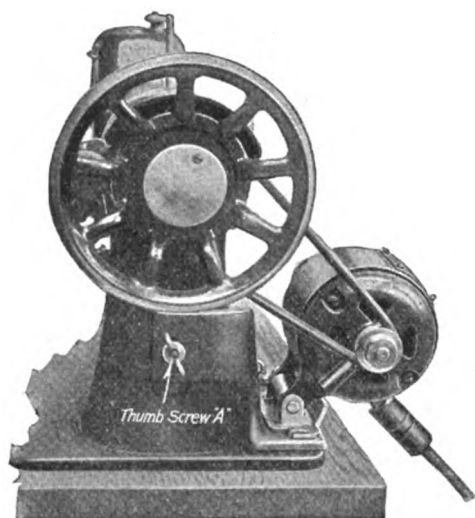
Table II—Attachments for Direct-Current and Alternating-Current Motors

Article	Style No.
Right-hand tapered chuck	164229
Left-hand tapered chuck	164230
Right-hand flange chuck	164231
Left-hand flange chuck	164232
Buffing wheel, 3-in. diam., 30-ply	121666
1 in. diam. stick of rouge, 3-in. long	134613
Carborundum wheel, 3-in. diam., 1/4-in. face, 1/4-in. bore	121665
Brush wheel, 3-in. diam.	125815
Adapter for Ritter chucks	164228
Set of Ritter chucks*	139589

\*Sold only in sets of eight, viz., three right-hand and three left-hand flange chucks, 1/4-inch, 1/8-inch and 3/16-inch hub, one left-hand tapered chuck for buffing wheels, and an adjustable chuck for drills, burs, etc. An adapter is necessary with each set.

## THE SEW MOTOR

All general makes of machines, new and old, except a few obsolete models, can be readily equipped with this motor and operated at a cost of only a fraction of a cent per hour for electric current.



MOTOR WITH SINGER BASE MOUNTED ON MACHINE

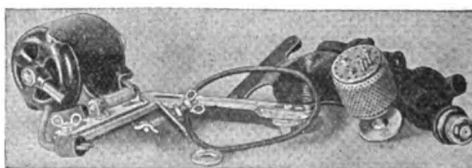
The complete outfit weighs less than 6 pounds, and employs many exclusive features of design. The drive is by means of a belt. A belt is supplied with the outfit and is used both for driving the sewing machine and for winding the bobbin. The motor is

so mounted that it can be swung into a position so that the sewing machine can be closed.

Each outfit as furnished consists of a motor, motor mounting, controller, and cord and plug. The outfit usually sold will be style No. 249779-A which has a motor mounting suitable for all general makes of family sewing machines of the drop head or stationary head type. The motor mounting for this style outfit consists of a flat "L" shaped steel base plate.

For the drop head Singer sewing machine manufactured since the first of 1914, style No. 252400-A is furnished. This outfit has a special mounting which allows the sew-motor to drop with the head of the machine. For Singer sewing machines manufactured before 1914 outfits style No. 249779-A should be supplied. However on this particular type of machine the head cannot be dropped with the motor attached. To close this type of machine the motor and mounting is removed in one piece by simply taking off one of the thumb screws.

The motor is a universal series-wound type which can be operated on circuit of 115 volts direct current, or 110 volts alternating current of any frequency up to 70 cycles.



COMPLETE OUTFIT WEIGHS ONLY ABOUT 6 POUNDS

## FACTORY SEWING-MACHINE MOTORS

ALTERNATING-CURRENT AND DIRECT-CURRENT

$\frac{1}{4}$  H.P.

60 CYCLES

1700 R.P.M.

The Westinghouse factory sewing-machine motor is designed for heavy sewing service such as is encountered in clothing shops, department stores, automobile top repair shops, awning and sail factories. It can be applied to any make of sewing machine and its use converts slow, tedious work into an easy, fast operation. The time required per piece is diminished and the cost of labor is reduced.

The motor is very quiet in operation and requires practically no attention. The needle is under the absolute control of the operator at all times. A slight pressure of the foot on the treadle is the only effort required to operate the machine even at a speed many times that obtainable when foot power is used.

### Description

**Motor and Clutch**—Modifications of the standard types CA alternating-current and CD direct-current motors are used on these outfits. The electrical characteristics of the alternating-current motor are the same as those of the standard starting duty clutchless type CA motor; those of the direct-current motor are the same as those of the compound-wound type CD motor. All the details of the mechanical construction of these motors are the same as those pertaining to the class 600 types CA and CD with the following exceptions:

The motor is furnished standard for inverted mounting and is fitted with a support for fastening to the under side of the sewing-machine table. The

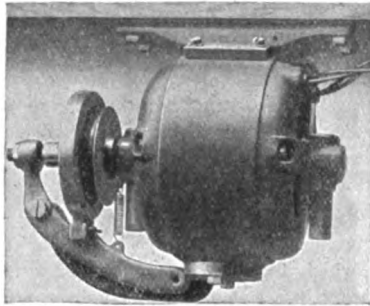
M-124A

FACTORY SEWING-MACHINE MOTORS—Continued

frame is machined to take the brake arm support, which is held to the frame by means of two tap bolts.

The shaft is longer than the standard and carries a combination clutch and pulley. Also the bearing is longer as it carries the pulley and a thrust bearing.

being started and stopped by the operation of the treadle. A slight pressure on the treadle causes the brake lever to act on the clutch disc, causing it to



ALTERNATING-CURRENT MOTOR

Full description of the motors will be found in this catalogue under types CD direct-current and CA alternating-current motors, respectively.

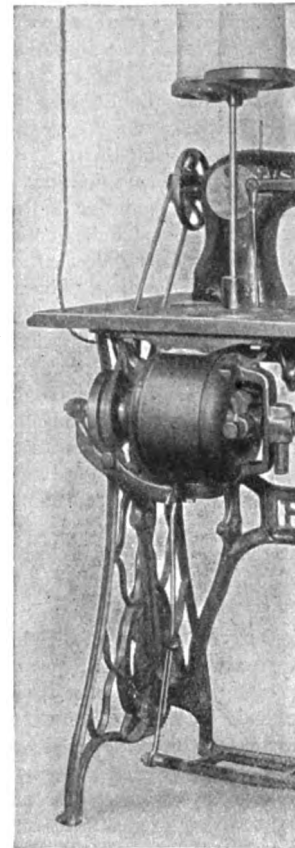
Application

The factory sewing-machine outfit is composed of a motor having a clutch mounted on one end of the shaft, an adjustable link or rod for connecting the treadle of the machine to the brake lever, and an angle-iron support on which are mounted a detachable plug and a snap switch.

The motor is mounted under the sewing-machine table, at the back, and is secured by means of four bolts. The treadle is disconnected from the wheel and the belt connecting the two wheels is removed. A belt is run from the motor pulley to the small hand wheel of the machine and the treadle is then connected to the brake arm on the motor by means of the connecting rod.

Operation

The operation of the sewing machine is not affected in any way, the only difference being that unnecessary work is eliminated and the capacity is greatly increased. The motor is started by means of the snap switch and runs continuously, the machine



DIRECT CURRENT MOTOR ATTACHED MACHINE

engage the pulley. At the same time the brake on the pulley is released and the motor operates the machine.

**Speed Variation**—Speed variation is obtained by varying the pressure applied to the treadle. When the pressure on the treadle is removed, a spring causes the brake lever to return to its original position, opening the clutch and applying the brake, causing the machine to stop instantly.

RATINGS AND APPROXIMATE WEIGHTS

H.P.	Full Load R.P.M.	Frame No.	Volts	Style* No.	Motor Complete Shipping Wt., Lbs.
<b>Alternating-Current—Single-Phase—60-Cycle</b>					
1/4	1725	643	110	230093	40
	1725	643	220	230094	40
<b>Direct-Current—Compound-Wound</b>					
1/4	1725	623	115	230095	42
	1725	623	230	230096	42

\*Style numbers cover motor complete with clutch, brake, control rod, and snap switch. The motors are arranged for mounting in an inverted position, directly beneath the sewing-machine table.

## POINTS OF IMPORTANCE IN SELECTING AND APPLYING SMALL MOTORS

When selecting small motors for application to a large number of individual machines of a class, precautions should be taken to select a motor with suitable characteristics. Each class of machines has its own peculiarities, and a Westinghouse motor is built or can be built to suit them.

Before deciding on the specifications of a motor for a class of machines, samples of the machines should be thoroughly tested under actual working conditions to determine the required effort or torque, both for starting and running. Some allowance must be made for unavoidable manufacturing variations, differences in materials, etc., which may cause some machines to require more power than others built as duplicates. The same unavoidable causes may result in slight differences in the characteristics of motors supposed to be duplicates, although customers can rest assured that all Westinghouse small motors will be as good, or better, than guarantees. Likewise, allowance must be made for variations in the characteristics of commercial electric circuits. The motor selection should be made with the worst probable conditions in view.

**Alternating-Current Motors—Split-phase Motors** should be selected with a starting torque that will bring the machine promptly up to speed. Allowance must be made for reduced voltage of commercial power and light circuits, since the starting torque developed by the motor varies as the square of the voltage of the circuit to which it is connected. On account of light wiring or insufficient transformer capacity, the voltage of many such circuits drops considerably at times. While the motor is starting, it is possible that the voltage at the motor terminals may be as low as 80 per cent of its rated value, and under this condition the starting torque of the motor is only approximately 64 per cent of its full voltage value. For these reasons, motors to drive machines from indiscriminate lighting circuits should be selected for the worst probable starting conditions.

Split-phase motors are used successfully on all applications where a starting torque greater than full load torque is not required, and where, owing to the size of motor or the liberal rules of the central station, the amount of starting current is not important. Such motors are generally used for washing machines, ironing machines, small fans and blowers, advertising novelties, duplicating machines, folding machines, peanut roasters, etc.

**Repulsion-Induction Motors** are successfully used on applications where the starting torque required is high, and where low starting current is necessary.

Uniform rules, adopted by the National Electric Light Association, to govern the installation and use of motors on central station distribution systems, permit motors requiring not more than 30 amperes starting current to be connected to 110-volt alternating-current circuits. This current value is that

indicated by a suitable well-damped ammeter in the motor circuit on the line side of the starting device, and is 75 per cent of the permissible locked rotor value, which would be 40 amperes.

**Polyphase Motors**, possessing few wearing parts and having high starting torque and high overload capacity, are adapted to industrial service where polyphase power circuits are available. Squirrel-cage motors are suitable for constant speed service; wound-rotor motors for varying speed service.

The maximum turning effort while the motor is running, which is usually called break-down or maximum torque, must also be ample for the worst load conditions which the machine will probably meet, with voltage at least 10 per cent below rated voltage.

**Direct-Current Motors**—The operating characteristics of direct-current motors depend very largely on the type of field windings employed. The following comparison applies to shunt, compound and series-wound motors of the same rating and hence with substantially the same rated full-load current.

(a) Shunt-wound motors when used without a starting rheostat take several times full-load current at start and develop a starting torque of two to three times full-load torque. When a starting rheostat is used the current is limited to approximately two times full-load current on the first point of the rheostat, in which case the torque developed is directly proportional to the starting current. Starting rheostats are supplied with motors of  $\frac{1}{2}$  h. p. and larger and should be used on somewhat smaller motors when the starts are frequent. The operating speed of the shunt motor is practically constant at all loads. Such motors are generally applicable unless the starting or overload conditions are too severe.

(b) Compound-wound motors will develop higher starting and maximum torques with the same current input than shunt-wound motors but the speed while operating varies more widely with the load. They should be applied where high starting torque is desired and where some change of speed with load is not objectionable. When it is necessary for a motor to make frequent starts, even though the torque required is not excessive, a compound winding should be used. When it is desired to start motors larger than  $\frac{1}{2}$  h.p. without the use of a starting rheostat a field winding containing a larger number of series turns than that used on standard compound-wound motors can be furnished. Compound-wound motors should be applied under practically the same conditions as single-phase clutch motors.

(c) Series-wound motors develop higher starting and maximum torques with a given current input than either shunt or compound-wound motors, but while operating the speed varies with the load, in-



## POINTS OF IMPORTANCE IN SELECTING AND APPLYING SMALL MOTORS—Continued

creasing to a dangerously high speed at light loads. Series motors are applicable where very high torque must be developed either while starting or operating and where varying speed with varying load is not objectionable. Series-wound motors are particularly adapted to fans of the propeller type, to operating valves and similar applications where the motor is directly connected to the load. Series-wound motors other than the smallest sizes should not be belted or applied where the load may become very light, since if the load is removed a dangerous speed may result.

**Mounting**—The motor should be so mounted on the driven machine that it will receive a free circulation of air and be protected from heavy dust, dirt, oil and water. Opportunity must be left for inspection, replenishing the lubricant and renewing the brushes. The motor must be held firmly in place to prevent injurious vibration.

**Method of Drive**—In belting small motors, the arc of contact between the belt and the motor pulley must be sufficient to prevent the belt from slipping, even if it becomes somewhat loose. If the distance between the centers of the motor pulley and the driven pulley is short, or if there is a great difference in size between the two pulleys, some device such as an idler pulley must be used to increase the arc of contact between the belt and the smaller pulley.

If the motor drives through gears or chains, the gears or sprockets must be lined up properly and run freely. Binding will waste power, decrease the life of the gears, chains and sprockets, and increase the noise.

If the motor and driven machine are direct-connected by a rigid coupling, the shafts must be aligned with the greatest accuracy; with a flexible coupling less care is necessary, but good alignment insures minimum loss of power and wear of bearings.

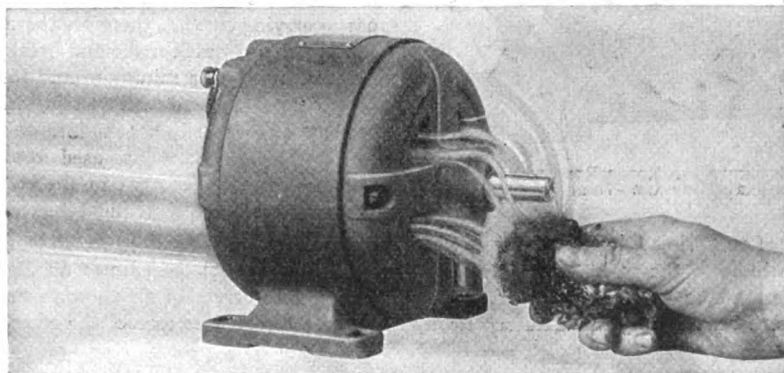
**Lubrication**—It is essential in order to obtain successful operation to properly lubricate both the motor and the driven machine. Directions for replenishing the lubricant and cautions against putting oil on the motor windings, commutator or brushes accompany each motor. A manufacturer reselling a motor in connection with his machine should send with each outfit full instructions covering the lubrication of the complete apparatus.

**Wiring**—The machine manufacturer should also keep in close touch with installations of his machines. He should cooperate with wiring contractors with a view to insuring correct wiring. The conductors to the motors must be large enough to carry the current without undue heating or voltage drop. For motors of  $\frac{1}{8}$  horsepower and larger, separate wires from the main switch are advisable.

**Heating**—If machines are intended for continuous service, hours at a time, one of them should be operated four or five hours under the worst possible working conditions and the motor temperature observed. If the temperature rise of the hottest part of the motor does not exceed 50 degrees Centigrade (90 degrees Fahrenheit) above the surrounding air, the application will be satisfactory. Care should be taken that the temperature measured is that of the hottest part, as the external frame will run several degrees cooler than the internal part where the heat is generated, because a strong current of air is being forced through the motor while it is running. The hottest part will in general be found to be the stator winding on an alternating-current motor, and the rotor winding on a direct-current motor. As long as the hand can be held on the windings of a motor without great discomfort, measurement of temperature is not essential. Beyond this point a thermometer should be used.

Many machines operate for short periods only, with intervals of rest, during which the motor can cool. Motors with ratings for intermittent service can be used in such cases, thus effecting some saving in cost; care must be taken, however, to guard against applying a motor that would overheat, if it is possible for it to be accidentally left in service continuously.

**Conservative Rating**—The service and reliability of a motor-driven device will be greatly enhanced by the use of a motor rated on a conservative basis. The cost of a motor slightly larger than required under favorable conditions may be a little greater than that of one just sufficient to drive a device, but the reputation that will be established by the device using a conservatively rated motor will more than outweigh the increase in cost.



SMOKING WASTE SHOWS THE STRONG AIR CURRENTS WHICH KEEP THE MOTOR COOL

M-102A

## TYPE CA ALTERNATING-CURRENT MOTORS

### SINGLE-PHASE OPEN TYPE



1/2 H.P. FRAME No. 443

Westinghouse type CA motors are split-phase induction motors which can be operated from a single-phase lighting circuit or from any phase of a polyphase power circuit to drive many small machines such as washing machines, sign flashers, small printing presses, blowers, etc.

### Construction

The **Stator** or stationary element, consists of the frame, primary core, and windings.

The frame is a cylindrical iron casting with the feet forming part of the casting. The feet are slotted for holding-down bolts and for the adjustment of belt tension.

The primary core is built up of steel punchings and rigidly mounted in the frame.



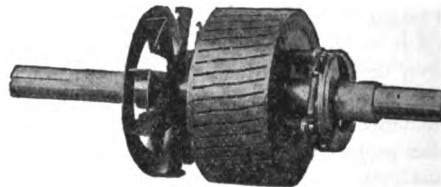
FRAME WITH BRACKETS AND ROTOR REMOVED, SHOWING PRIMARY CORE AND WINDINGS

In the slots of the primary core are inserted the two primary windings, the main and the starting windings. The starting winding is in circuit only while the motor is accelerating and is automatically

cut out by the starting switch when a predetermined speed has been reached.

The **Rotor** is of the squirrel-cage type and is therefore practically indestructible. The shaft is made of axle steel which is tougher and stronger than the machinery steel usually employed. The shafts have "flats" for grooved pulleys since "flats" make it easier for unskilled operators to remove the pulleys.

Mounted on one end of the rotor is the centrifugal operating ring of the starting switch. On the inside of the bearing bracket and insulated from it is the stationary part of the switch. When the rotor is at rest the switch is closed as shown in the cut of the bracket. The upper contacts are mounted on a movable slide which may be moved upward a short

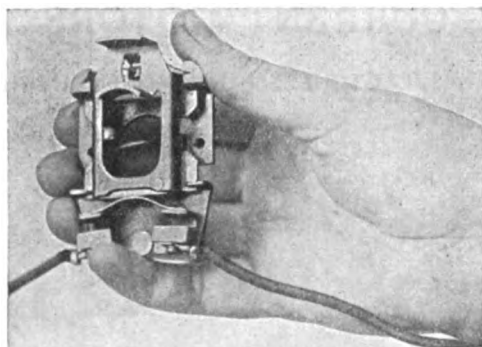


ROTOR SHOWING CENTRIFUGAL OPERATING RING AND VENTILATING FAN

distance from the position shown. When the rotor starts the centrifugal operating ring mounted on the rotor does not touch the starting switch until a predetermined speed is reached when the ring expands. For an instant the ring presses against the upper lip on the slide and causes it to move upwards past the reach of the ring to the limit of its travel where it is held by two steel springs. When the speed drops sufficiently to allow the ring to close, the lower lip on the slide is pressed for an instant by the ring so that the contacts close. The slide travels past the reach of the operating ring due to the action of the springs, which hold the slide up when it is thrown up and hold it down when it is thrown down, thus eliminating wear of both the ring and switch. The ring never carries current; nor comes in contact with parts carrying current; therefore there are no sliding contacts but a quick make-and-break action. This reduces arcing to a minimum and insures long life as evidenced by an actual test in which one of the smallest of these switches made more than a million starts. These switches are used in all but the 300 frame. There the current in the starting winding is so small that the centrifugal finger type of switch gives satisfactory service.

A ventilating plate mounted on the rotor forces a continuous current of air through the motor. The air is so directed as to cool the cores and windings

TYPE CA ALTERNATING-CURRENT MOTORS—Continued



THE SWITCH THAT MADE MORE THAN A MILLION STARTS

thoroughly, thus maintaining practically uniform temperature and avoiding localized heating.

**Brackets** are cast integral with the frame. This construction also permits a more compact design with less weight.

The bearings are bronze bushings pressed into the housings which form part of the brackets. Metal caps and rings fitting tightly in the bearing housings make the bearings practically dust-proof.

An additional charge is made for all wall or ceiling mounting motors and all inquiries for them should be referred to the Works.

**Terminal** leads are brought out to insulated binding posts to permit ready connection. The direction of rotation can be reversed by interchanging the terminal leads.

**Lubrication** of motor bearings is provided by means of wick-fed grease cups so that these motors can be used on small portable apparatus which may require considerable handling and may be run in a tilted position or momentarily turned upside down without spilling the lubricant. A good grade of unmedicated vaseline is ordinarily used for the lubricant, although, if a motor with grease cups is always to remain in one position where oil will not spill out, a good grade of machine oil may be used.

The **finish** is glossy black japan, a finish attractive in appearance and possessing good wearing qualities.

**Interchangeability** of type CA motors, rating for rating, with type CD direct-current motors with respect to mountings and principal dimensions

makes it necessary for the user to provide only one mounting for either direct or alternating-current motors whether the motors are direct connected, geared or belted.

**Accessories**

**Pulleys**—Grooved pulleys are standard for these motors. Only standard pulleys are carried in stock but pulleys smaller than standard may be used. The smallest pulleys listed in the table of ratings are those with minimum allowable diameter and maximum allowable face.

**Performance Guarantees**

The temperature rise of all parts, when operating under normal rated conditions as specified on the name plate and at 100 per cent rated load, will not exceed 40 degrees Centigrade.

Type CA motors have a starting torque of from 1 to 1½ times full load torque and a breakdown or maximum torque of from 1¾ to 2 times full load torque.

Type CA motors will operate successfully with normal rated current and frequency at any voltage not more than 10 per cent above or below normal but not necessarily in accordance with the standards of performance established for operation at normal rating.

**Care and Operation**

Note the nameplate reading to see that it agrees with the circuit to which the motor is to be connected.

**Lubrication**—Unscrew the cup below each bearing and fill with unmedicated vaseline or good machine oil. Replace the cup, making certain that the wick presses against the shaft, then tighten the cup securely to prevent its working loose.

Motors are shipped with the reservoirs filled but the above precautions should always be taken as good lubrication is of prime importance to all electric motors. Although these bearings will run much longer under normal service conditions, replenishing the lubricant once a month is strongly recommended.

**Connections**—Type CA motors can be connected to any phase of a 2-phase or 3-phase circuit of proper voltage and frequency.

**RATINGS**

Hp. 40°c Cont.	No. Poles	Rpm. At Full Load	Frame No.	BARE MOTOR		STANDARD PAPER Style No.	PULLEYS	
				110 Volts *Style No.	220 Volts *Style No.		Dia. X Face	Special Min. Y Max. Dia. A Face
<b>STANDARD STARTING DUTY WITHOUT CLUTCHES</b>								
<b>60 Cycle—110-220 Volts</b>								
½	4	1750	343	156763	156764	174088	1½†	....
¼	4	1750	443	156767-A	156768-A	106802	1½‡	....

\*Style number does not include sliding base or pulleys.  
 †Single groove pulley for ¼-inch round belt; diameter applies to pitch circle.  
 ‡Single groove pulley for ½-inch round belt; diameter applies to pitch circle.

# TYPE CAH ALTERNATING-CURRENT MOTORS

**SINGLE-PHASE**

**SPLASH-PROOF**

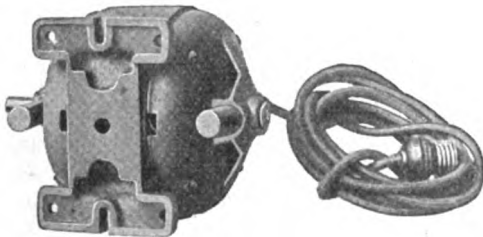
**CLUTCHLESS AND WITH CLUTCH**

$\frac{1}{8}$ ,  $\frac{1}{6}$  AND  $\frac{1}{4}$  H.P.

Many small-motor applications, such as washing machines, water pumps, dish washers, etc., require compact splash-proof motors with high starting and break-down torques. The type CAH motor possesses not only these desirable characteristics but many others, and can be operated from single-phase commercial lighting circuits. It is ingeniously designed and constructed so as to exclude water and small falling objects, yet it has ample ventilation through the peculiar ducts in the end brackets, making it suitable for a wide range of application.

### Construction

The frame is of cast iron construction and cylindrical in form with the feet forming a part of the casting. Drilled holes are provided for four-point mounting. Cast slots are provided for two-point mounting which also facilitates belt tension adjustment.

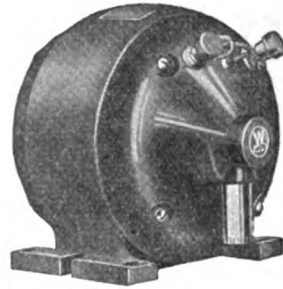


BOTTOM OF MOTOR WITH CORD AND PLUG SHOWING THE SLOTTED FEET AND THE VENTILATING DUCTS

Within the frame are mounted the primary core punchings and the two primary windings the same as in the type CA motor.

The bearing brackets are cast separate from the frame, permitting them to be turned 90 or 180 degrees for either wall or ceiling mounting. Motors will be furnished, however, arranged for floor mounting unless otherwise specified on order.

The bearings are large bronze bushings pressed into the housings which form part of the brackets.



MOTOR WITH BINDING POSTS

**Lubrication** of type CAH motors is by means of wick-fed grease cups filled with vaseline or a good grade of machine oil.

**Interchangeability**—When required, type CDH direct-current motors can be furnished which have the same mounting dimensions as 60-cycle type CAH motors, making it possible for the user to provide one mounting for either direct or 60-cycle alternating-current motors whether the motors are direct connected, geared or belted.

**Starting Torque**—The starting torque is  $1\frac{1}{2}$  times full load torque and the break-down, or maximum torque, is 2 times full load torque.

### Accessories

The pulley furnished with type CAH motors is a single groove iron pulley with a 2-inch diameter of pitch circle for a  $\frac{5}{16}$ -inch round belt.

**Cord and Plug** can be supplied with or without binding post cover.



ROTOR SHOWING CENTRIFUGAL OPERATING RING AND VENTILATING PLATE

## RATINGS

### Single-Phase

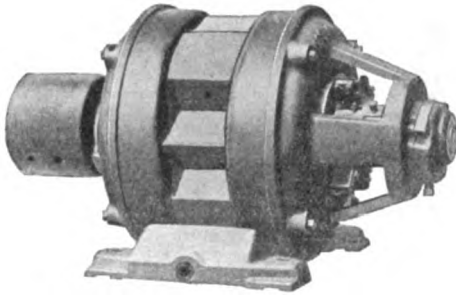
Hp.	Rpm.	Frame No.	Rotation†	STYLE NO.			
				110 VOLTS		220 VOLTS	
				Cord and Plug	Binding Post	Cord and Plug	Binding Post
				<b>60-Cycle 110-220 Volts</b>			
	1750	445	C	277215	277211	277217	277212
	1750	543	C	245225	245209	245227	245210
	1750	545	C	245241	245217	245243	245218

†Viewed from end opposite pulley.

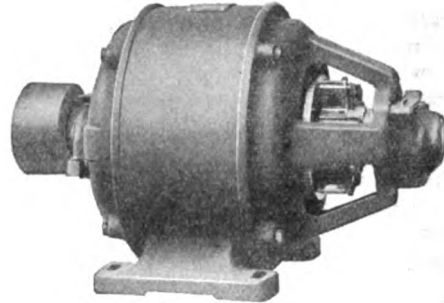
## TYPE AR ALTERNATING-CURRENT MOTORS

SINGLE-PHASE      CONSTANT SPEED      REPULSION-INDUCTION

½ TO 10 H.P.



CONSTRUCTION OF 2-H.P. MOTORS AND LARGER



CONSTRUCTION OF MOTORS FROM ¼-H.P.,  
6-POLE, TO 1½-H.P., INCLUSIVE

Westinghouse type AR motors fulfill the demand for simple, reliable single-phase motors having high starting torque or turning effort with low starting current for such applications as rotary blowers, compressors, pumps, etc. They are automatically self-starting and require no starting device except a double-pole switch or circuit-breaker. A starting rheostat can be supplied, however, where especially low starting current is desired, although the starting torque is reduced proportionally.

The efficiency and power factor of these motors are high at full loads and the overload capacity is ample.

### Construction

The frames of all type AR motors of 1½ h. p. and smaller are cylindrical iron castings made in one piece with the feet which have slots for holding-down bolts and for adjusting belt tension. Within the frames are the primary core punchings in which the single primary winding is wound.

Type AR motors of 2 h. p. and larger have frames built up of steel laminations similar to the standard type CS motor construction in the same sizes.

**Secondary**—On motors up to and including 1½ h. p. the secondary laminations are bolted together, and the core thus formed is pressed on a knurled shaft. On motors above 1½ h. p. the secondary laminations with spacers for ventilating

ducts are riveted between end plates and the unit thus formed is keyed to the shaft.

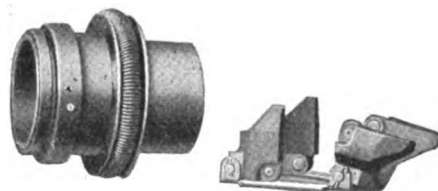
**Short-Circuiter**—The mechanism which short-circuits the rotor windings and releases the brushes is located inside the rotor at the commutator end. It consists of a sleeve, centrifugal weights and a spring—the whole being retained in place by a nut on the shaft. The sleeve carries a short-circuiting coil which consists of a helical phosphor-bronze spring inside of which is a ring of flexible copper shunts.

When the motor is at rest, the short-circuiting sleeve is pressed back into the rotor by the spring. When the motor speeds up, centrifugal force causes the weights to move outward, and the sleeve is forced forward. At nearly full speed, the short-circuiting coil is forced under the ends of the commutator bars and into very close contact with them, thus completely short-circuiting them. At the same time the end sleeve relieves the spring tension on the brushes, and being free to move away from the commutator they are pushed back by the end-play of the rotor. This action takes place on all except the ½-horsepower, 4-pole motor, in which the brushes remain in contact with the commutator when the short-circuiting coil is forced under the ends of the commutator bars.

The bearing brackets are cast separate from the frames, permitting the brackets to be rotated 90 or 180 degrees for either wall or ceiling mounting. The motors are regularly supplied for floor mounting but can be arranged for wall or ceiling mounting if so specified on the order.



STATOR



SHORT-CIRCUITING SLEEVE AND CENTRIFUGAL  
SHORT-CIRCUITER

M-1067

TYPE AR ALTERNATING-CURRENT MOTORS—Continued

The bearings of the smaller motors are bronze bushings, pressed into the housings and pinned in place. The bearings of larger motors are babbitt-lined sleeves.

**Brushes**—The carbon brushes are pressed against the commutator by steel or bronze springs. With the exception of the smallest motor the spring tension is removed and the brushes leave the commutator when the motor attains full speed. The brushholders are carried by a rocker ring which is mounted on a machined seat on the front bearing housing. The position of this ring determines the direction of rotation of the motor. Standard motors are shipped arranged for clockwise rotation viewed from end opposite the pulley.

The terminals of the type AR motors are brought out to terminal blocks on the side of the motors. The connections are so arranged that the motors can be connected to circuits of either 110 or 220 volts.

**Lubrication**—Oil-ring lubrication is used and the oil wells are provided with an overflow gauge, a drain plug, except on small sizes, and a covered opening for filling the well and inspecting the oil-ring.

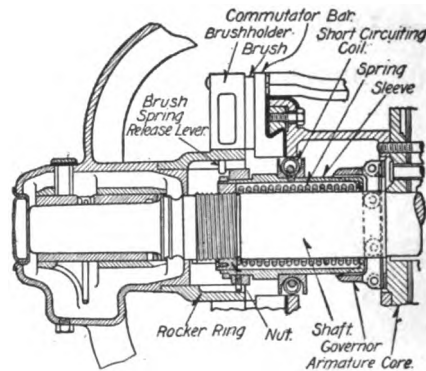


DIAGRAM OF SHORT-CIRCUITING SWITCH

Accessories

The rheostats used with type AR motors when especially low starting current is desired are of the face-plate type with low-voltage release.

Paper pulleys can be furnished for all type AR motors.

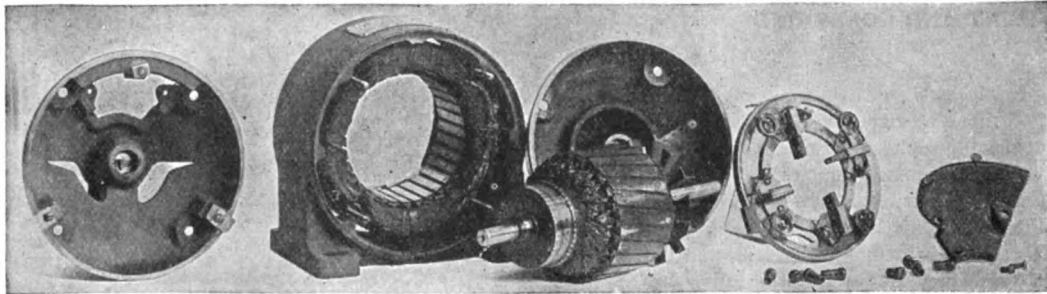
Slide rails can be furnished for motors on the 400 frames and larger. For smaller motors sliding bases provided with screws for adjusting belt tension can be supplied.

RATINGS AND APPROXIMATE WEIGHTS

H.P.	No. Poles	Full Load R.P.M.	Frame No.	Standard*† Pulley Dia. x Face Inches	Special† Pulley Min. X Max. Dia. X Face Inches	APPROX. SHIPPING WEIGHT IN LBS. Motor With Pulley	Add for Sliding Base	Add for Rheostat
<b>60 Cycles</b>								
1/2	4	1750	065	3 1/2 x 2 1/2	2 x 3	85	20†	..
1/2	6	1160	173	3 1/2 x 2 1/2	2 1/4 x 3	130	20†	..
3/4	4	1750	144	3 1/2 x 2 1/2	2 1/4 x 3	135	20†	..
3/4	6	1160	165	3 1/2 x 2 1/2	2 1/2 x 3	145	20†	..
1	4	1750	145	3 1/2 x 2 1/2	2 1/2 x 3	145	20†	35
1	6	1160	167	3 1/2 x 3	2 1/4 x 3	160	20†	35
1 1/2	4	1750	147	3 1/2 x 3	2 1/4 x 3	160	20	35
2	4	1750	326	4 x 3	3 x 6 1/2	240	25	35
2	6	1160	330	4 x 4	3 x 6 1/2	285	25	35
3	4	1750	330	4 x 4	3 x 6 1/2	285	25	35
3	6	1160	460	5 x 4 1/2	4 x 10	475	35**	35
5	4	1750	460	5 x 4 1/2	4 x 10	475	35**	35
5	6	1160	555	7 x 6	4 x 10	655	50**	35
7 1/2	4	1750	555	7 x 6	4 x 10	655	50**	40
7 1/2	6	1160	555	7 x 6	4 x 10	655	50**	40
10	4	1750	555	7 x 6	4 x 10	655	50**	50
10	6	1160	575	7 x 6	6 x 10	775	50**	50
<b>50 Cycles</b>								
1/2	4	1460	065	3 1/2 x 2 1/2	2 x 3	80	25	..
1/2	6	970	163	3 1/2 x 2 1/2	2 1/4 x 3	140	25	..
3/4	4	1460	143	3 1/2 x 2 1/2	2 1/4 x 3	130	25	..
3/4	6	970	165	3 1/2 x 2 1/2	2 1/2 x 3	150	25	25
1	4	1460	145	3 1/2 x 2 1/2	2 1/2 x 3	140	25	35
<b>40 Cycles</b>								
1 1/2	4	1170	163	3 1/2 x 2 1/2	2 1/4 x 3	140	25	..
1	4	1170	167	3 1/2 x 3	2 1/4 x 3	155	25	35
2	4	1170	330	4 x 4	3 x 6 1/2	280	30	35
<b>25 Cycles</b>								
1/2	2	1450	143	3 1/2 x 2 1/2	2 1/4 x 3	130	25	..
3/4	2	1450	145	3 1/2 x 2 1/2	2 1/2 x 3	140	25	..
1	2	1450	127	3 1/2 x 3	2 1/4 x 3	155	25	35
2	2	1450	330	4 x 4	3 x 6 1/2	280	30	35

We will not, under any circumstances, guarantee motors if operated with pulleys of dimensions smaller than those listed above.  
 \*Dimensions specified are in inches and refer to diameter and face respectively.  
 †Pulleys require special offset hub in most cases. Pulleys of wider face require special shaft extension.  
 ‡Motors in frames 167 and smaller have feet slotted for belt adjustment so the sliding bases can be omitted.  
 \*\*Frames 400, 555 and 575 are provided with rails instead of sliding bases.

## TYPE ARS REPULSION-INDUCTION MOTORS



TYPE ARS MOTOR DISASSEMBLED

The type ARS motor is a repulsion-induction motor, especially designed for pumps and other apparatus requiring large starting torque and where low starting current is essential.

Armature windings of the repulsion and squirrel-cage types are used, both of which are active at all times. No centrifugal devices of any kind are employed. The windings are so proportioned that, at full load, the motor will run slightly below synchronous speed, and, at no-load, approximately 15 per cent above synchronous speed.

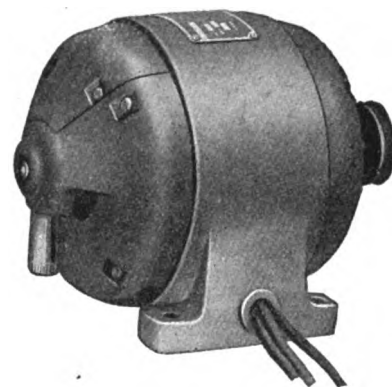
This motor has a starting torque of approximately 2 times full load torque, with 3 to 3½ times full load current, which is about 33 to 50 per cent of the starting current of split-phase motors.

Type ARS motor is mounted in a semi-enclosed housing having protected openings and carefully designed ventilating ducts, thus maintaining a uniform temperature which prevents hot spots. Except when surrounded by steam and fumes, or suspended dirt, all requirements of an enclosed motor are met. The bearings and grease cups are large, insuring ample lubrication and long life. One-half horsepower motors have oil-ring lubrication. All other sizes are equipped with grease cups.

Motors having the grease-cup type of bearings are shipped with the reservoirs filled but precautions should always be taken as good lubrication is of prime importance to all electric motors. Although these bearings will run much longer under normal

service conditions, replenishing the lubricant in all types of bearings once a month is strongly recommended. About once a year the reservoirs of the oil-ring type bearings should be emptied and cleaned out with gasoline or kerosene to remove any dirt or sediment from the oil

**Voltage**—Each motor is provided with four leads, which can be connected to operate on circuits of either 110 or 220 volts, according to instructions on tag sent with each motor. Type ARS motors will operate at full rating continuously without injury on 10 per cent higher or lower than rated voltage.



SHOWING CONSTRUCTION OF SEMI-ENCLOSED, DRIP-PROOF FRAME

### RATINGS, TYPE ARS

H.P.	Volts	Phase	Cycles	Poles	R.P.M.	Frame No.	Pulley Sizes Inches	Approx. Net Weight Lbs. With Bedplate
1/8	110-220	1	60	4	1725	25-B	2*	24 1/2
1/8	110-220	1	60	4	1725	25-B	2*	24 1/2
1/8	110-220	1	60	6	1100	55-C	3x1 1/4	61
1/8	110-220	1	60	4	1725	35-B	2*	35
1/8	110-220	1	50	4	1400	35-B	2*	35
							Diam. & Face	
1/2	110-220	1	60	4	1725	55-B	3x1 1/4	61
1/2	110-220	1	60	6	1100	75-C	3 3/4 x 2 1/4	.....
1	110-220	1	60	4	1725	75-B	3 3/4 x 2 1/4	.....

\*Pitch diameter, groove pulley, 1/4-inch diameter leather belt.

## TYPE CD DIRECT-CURRENT MOTORS

### SHUNT AND COMPOUND

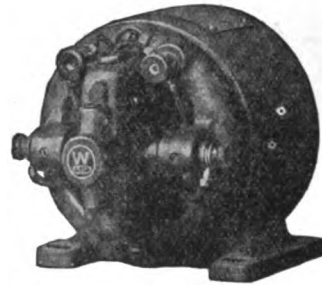
### OPEN

1/20 TO 3 H.P.

In places where direct-current circuits are available the Westinghouse type CD motor is suitable for driving such small devices as washing machines, vacuum cleaners, job presses, conveyors, drill presses, pumps, etc. Type CD motors are well designed for strength and compactness and will operate successfully with hard usage and unskilled handling to which they are often subjected.

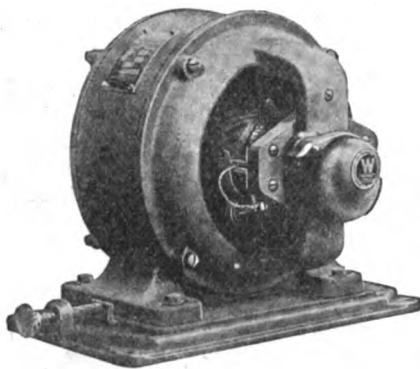
### Construction

Frames 700 to 900 inclusive consist of a forged steel ring to which the feet are bolted. The pole pieces of these frames are built up of laminated

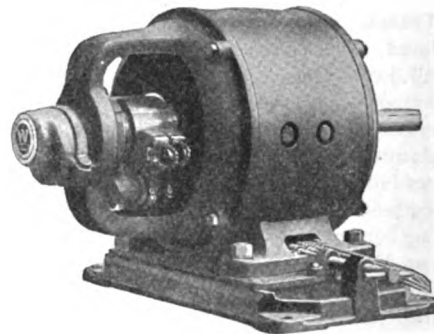


TYPE CD MOTOR, FRAMES 300 AND 400

A ventilating fan mounted on the shaft circulates air through the frame and around the windings, effectually cooling them and preventing "hot spots."



TYPE CD MOTOR, FRAME 700



TYPE CD MOTOR, FRAME 900

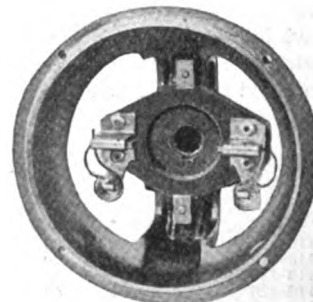
steel, securely riveted together and bolted to the frame. This construction reduces the weight per horsepower to a minimum.

On the two smaller sizes, frames 300 and 400, the frames are strong iron castings with the feet and poles cast integral.

The field coils are form wound, thoroughly taped and dipped in high grade insulating moisture-resisting compound.

The armature core is built up of steel punchings rigidly mounted on a shaft of ample size and strength manufactured from axle steel, which is much stronger and tougher for the same dimensions than the machinery steel generally used.

Lubrication on frames 300 and 400 is by means of wick-fed grease cups permitting these motors to be mounted on small portable apparatus which may be tilted or momentarily inverted without spilling the lubricant. The oil ring type



INTERIOR OF FRONT BRACKET SHOWING BRUSHHOLDERS OF 700 FRAME



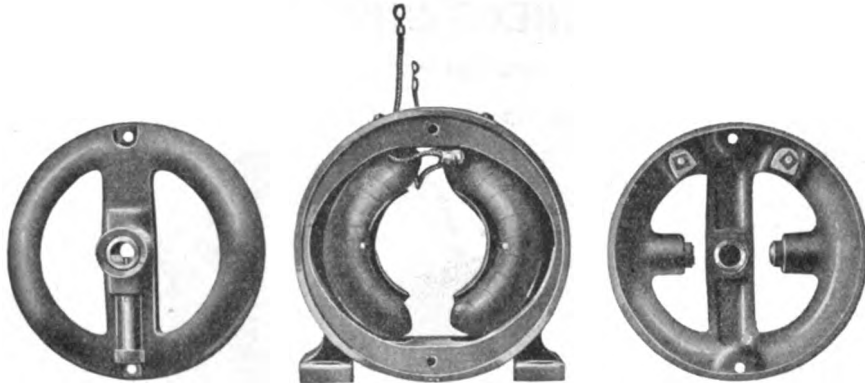
ARMATURE FOR 1/4 H.P. MOTOR

of lubrication successfully used for many years on electrical machinery is employed on frames 700 to 900 inclusive.

M-109A



TYPE CD DIRECT-CURRENT MOTORS—Continued



FRAME AND BRACKETS FOR THE 500 FRAME

Accessories

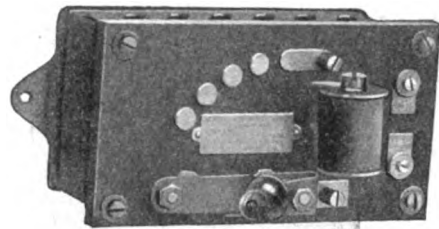
A sliding bedplate suitable for floor, wall or ceiling suspension can be supplied with class 700 and larger frames.



SLIDING BEDPLATE

Pulleys—Crowned paper pulleys are supplied with frames 700 and larger, and grooved steel pulleys with the smaller frames.

Starting Rheostats—Starting rheostats should be used with all shunt and compound-wound motors of 1/2 horsepower and larger.



STARTING RHEOSTAT

RATINGS

Hp.	Approx. Rpm. at Full Load	Frame No.	Std. Pulley Dia. x Face	APPROX. NET WT., LBS.	
				Bare Motor	Add for Sliding Base
<b>115-230 Volts Shunt and Compound Wound</b>					
1/20	1700	323	1 1/8*	10	..
1/12	1725	423	1 1/8†	15	..
1/8	1725	723	3 1/2 x 2 1/2	45	12
1/4	1140	725	3 1/2 x 2 1/2	54	12
3/8	1725	725	3 1/2 x 2 1/2	54	12
1/2	1140	823	3 1/2 x 3	84	23
1	1725	823	3 1/2 x 3	84	23
1	1140	825	3 1/2 x 3	100	23
1	565	923	4x3	170	30
1 1/2	1725	825	3 1/2 x 3	100	23
1 1/2	1180	923	4x3	170	30
1 1/2	800	925	4x3	195	30

Hp.	Approx. Rpm. at Full Load	Frame No.	Std. Pulley Dia. x Face	APPROX. NET WT., LBS.	
				Bare Motor	Add for Sliding Base
<b>115-230 Volts Shunt and Compound Wound</b>					
2	1725	923	4x3	170	30
2	1180	925	4x3	195	30
3	1725	925	4x3	195	30
<b>32 Volts Compound Wound</b>					
1/2	1725	723	3 1/2 x 2 1/2	45	12
<b>550 Volts Shunt and Compound Wound</b>					
1	1000	923	4x3	170	30
1 1/2	1300	923	4x3	170	30
1 1/2	1000	925	4x3	195	30
2	1850	923	4x3	170	30
2	1350	925	4x3	195	30
3	1900	925	4x3	195	30

\*Single groove pulley for 1/4-inch round belt, diameter applies to pitch circle.  
 †Single groove pulley for 1/8 inch round belt, diameter applies to pitch circle.

## TYPE CDH DIRECT-CURRENT MOTORS

COMPOUND WOUND

SPLASH PROOF

1/8, 1/6, 1/4 AND 1/2 H.P.

32, 115 AND 230 VOLTS

Type CDH direct-current motors have been designed and constructed in order to incorporate in a direct-current motor the splash-proof feature which has been so popular in the Westinghouse type CAH alternating-current motors.

Large commutators and box-type brushholders with large brush area, make these motors particularly well adapted for operation from low-voltage storage battery plants, now being installed in great numbers on farms and in suburban residences.

**Construction**—The internal parts of these motors are built along the same lines, and are very similar to those of the type CD motors.



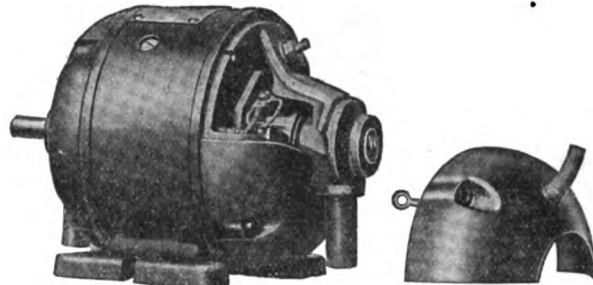
TYPE CDH MOTOR

**Frame and Field Poles**—The frame consists of a seamless forged-steel ring to which the cast-iron foot, and end brackets are bolted. The pole pieces which are built up of sheet steel laminations securely riveted together under pressure, are bolted to the steel ring. The shunt and series field coils are effectively insulated from each other, and from the frame and pole pieces by several layers of tape. The complete coil is treated with an insulating moisture-resisting compound and baked in an oven until thoroughly dry.

**Bearing Brackets**—The bearing brackets are of cast iron, each bracket being bolted to the frame by four screws, which permit turning the bracket through 90 or 180 degrees when the motor is mounted on the side-wall or ceiling. The commutator end bracket is provided with a cover which when removed allows easy access to brushes, commutator and terminals.



ARMATURE OF TYPE CDH MOTOR



TYPE CDH MOTOR SHOWING UPPER END BRACKET REMOVED

**Armature**—The armature core is built up of electrical sheet steel laminations pressed on a knurled shaft made from a special grade axle steel, such as used for the axles of all Westinghouse motors.

**Brushholders**—The two box-type brushholders of pressed steel protected from rust by a special treatment, are carried on a supporting plate of Bakelite Micarta.

**Bearings**—The bearings are bronze bushings pressed into the bearing housings which form part of the bearing brackets. These bronze sleeve bearings together with the efficient lubricating system provided results in long life, freedom from bearing trouble, and quiet operation.

**Lubrication**—Grease cups of large capacity, and provided with a wool wick pressed against the shaft by a coiled steel spring, are screwed into the lower part of the bearing housing. When filled with a good grade of unmedicated vaseline or machine oil, attention is required only at infrequent intervals.

**Ventilation**—Type CDH motors are effectively ventilated by means of a fan mounted on the armature shaft. Due to this fan and the shape of the brackets, a steady circulation of air is maintained through the motor, cooling all parts of the windings.

**Mounting**—Type CDH motors may be arranged for mounting on floor, side-wall, or ceiling. For directions as to mounting see Instruction Card which accompanies each motor.

**Interchangeability**—Alternating-current motors of similar ratings to the type CDH motors listed, have the same mounting dimensions, making it possible for the user to provide one mounting for either alternating or direct-current motors regardless of the method of drive employed.

### Ratings

Hp.	Full Load Rpm.	Frame No.	Std.* Pulley	APPROX. NET WT., LBS. Bare Motor	ADD FOR SLIDING BASE
<b>115-230-32 Volts</b>					
1/8	1725	425	2	15 1/2	3 1/2
1/6	1725	525	2	21	3 1/2
1/4	1725	525	2	23	3 1/2
1/2	1725	625	3 1/2	50	5

\*Single groove pulley for 1/4-inch round belt, diameter applies to pitch circle.

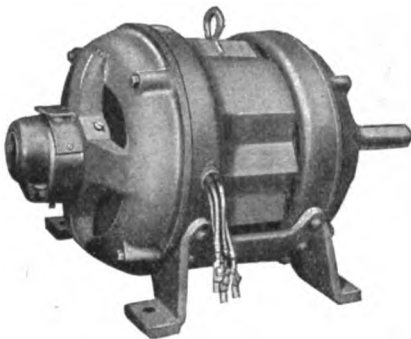
†Flat pulley 3—1 1/4-in. is furnished with 1/2 HP. motors.

## POLYPHASE INDUCTION MOTORS

### TYPES CSA AND CS SQUIRREL-CAGE INDUCTION MOTORS

For Constant Speed Continuous Service

¼ HP. to 200 HP. AND HIGHER, 2 AND 3-PHASE, 25, 40, 50 AND 60 CYCLES  
110, 220, 440, 550 AND 2200 VOLTS



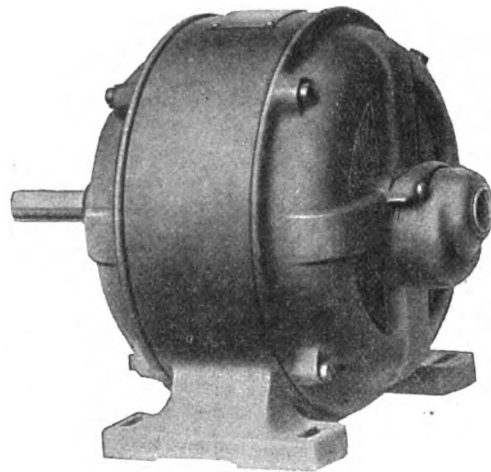
10 HP. TYPE CS MOTOR

In choosing a motor for any application, careful consideration should be given to the motor's characteristics, that it may be best adapted for the service required.

Alternating-current induction motors are classified according to their secondary windings as squirrel-cage or wound-rotor. Both these classes may be considered as either constant speed or varying speed according to the amount of resistance which is put into the secondary or rotor winding. There is on the market today no satisfactory alternating-current adjustable-speed motor corresponding to the direct-current machine tool motor and an alternating-current motor should not be applied for adjustable-speed work, where a wide range of speeds is required coupled with practically no change in speed from no load to full load on any setting.

The drop in speed of an induction motor from no load to full load is called the "slip" and is proportional to the amount of resistance in the rotor winding. If a motor has a small slip, that is, a low resistance in the rotor winding it is considered a constant speed motor and compares in its speed torque characteristics with the direct-current shunt-wound motor. If the motor has a comparatively high slip or high resistance rotor winding it compares with a shunt-wound direct-current motor operating with resistance in series with the armature winding and is therefore suited to varying speed work such as is usually performed by a direct-current motor of the heavily compounded or series type.

Low-slip motors, having a slip of from two to five per cent, of either the squirrel-cage or wound-rotor type, are used for constant speed work of all kinds such as motor-generators, centrifugal pumps, textile machinery and the like. The selection of a squirrel-cage or wound-rotor motor depends on the effect of the starting conditions on the generator and line. A low-slip squirrel-cage motor should not be connected to a line where the capacity of the motor exceeds thirty-five per cent of the capacity of the generator supplying power, especially, if the starting conditions are severe. The reason for this is, that a squirrel-cage motor with low resistance rotor winding, when starting, develops a comparatively lower torque, with higher current and at a lower power factor than a wound-rotor motor.



2 HP. TYPE CSA MOTOR

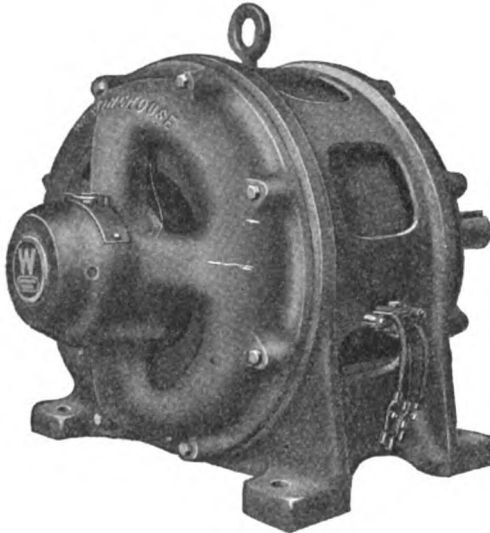
All these conditions act adversely on the generator and line and have a tendency to cause the voltage to fall which in turn decreases the starting torque and in the case of poorly chosen conditions results in failure of the application. A low-slip squirrel-cage motor of the usual design has starting torques not less than the following with full line voltage applied:

For 2-pole motors 150 per cent of full load torque.  
For 4-pole motors 150 per cent of full load torque.  
For 6-pole motors 135 per cent of full load torque.

## POLYPHASE INDUCTION MOTORS—Continued

## TYPES CSA AND CS SQUIRREL-CAGE INDUCTION MOTORS

For 8-pole motors 125 per cent of full load torque.  
 For 10-pole motors 120 per cent of full load torque.  
 For 12-pole motors 115 per cent of full load torque.  
 For 14-pole motors 110 per cent of full load torque.



50 HP. TYPE CS MOTOR

It requires from 3 to  $4\frac{1}{2}$  times full load current from the line to develop full load torque with a reduced voltage applied. A wound-rotor motor will start any load not exceeding its maximum torque and will draw from the line not over  $1\frac{1}{4}$  times full-load current for full-load torque with the proper resistance inserted between collector rings. The maximum running torque or pull-out torque, of squirrel-cage motors with rated voltage applied is not less than 200 per cent of full load torque. For

wound-rotor motors, this value is not less than 170 per cent. Squirrel-cage motors of somewhat higher slip, say eight to twelve per cent, are used where the starting torque required is high compared with the running torque or where flywheels are employed in connection with the driven machine. To function properly the speed of the flywheel must vary, and at least ten per cent variation in speed is required to do this. For this reason and because flywheels start hard, standard low-slip squirrel-cage motors should never be used on such applications.

Squirrel-cage motors of still greater slip, usually twenty per cent, are used for elevator and hoist work where the greater part of the operating cycle is consumed in starting and accelerating the load.

Westinghouse type CS motors are designed for general constant speed service, and are, therefore, suited for driving machines in practically all industries. These motors are made in all standard sizes of 2 horsepower and larger.

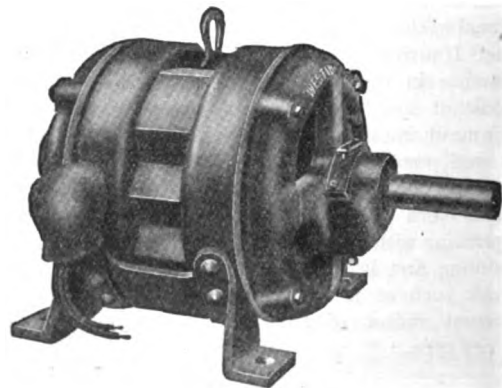
The design and construction are very simple, the number of parts being few, and interchangeable wherever possible. Thus, when necessary, renewals may be quickly and easily made. The rotors are practically indestructible; the bearings have very liberal areas, giving them long life. They are non-leaking, and are protected from dust.

The efficiency, power factor, and overload capacity, are high. Special attention has been given to the efficiency, not only at full load, but also at fractional loads, since high efficiency means low operating costs.

Besides the standard type CS motors they are made with vertical shafts, conduit terminal boxes, back gears, double extended shafts, and special impregnated windings. Special elevator motors can also be furnished.



TYPE CS VERTICAL MOTOR

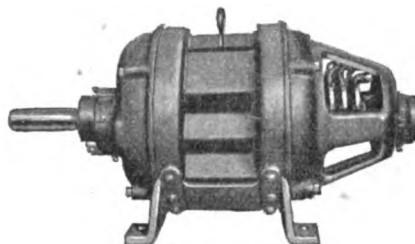
10 HP. TYPE CS MOTOR  
ARRANGED FOR CONDUIT WIRING

## POLYPHASE INDUCTION MOTORS—Continued

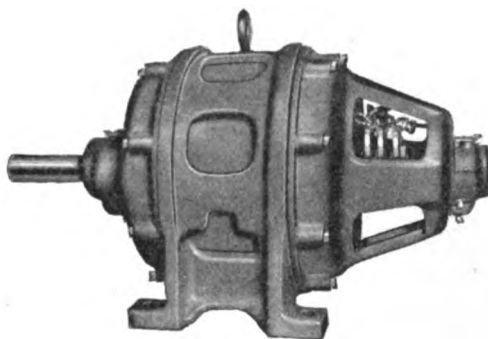
**TYPE CW WOUND-ROTOR INDUCTION MOTORS****For Constant and Varying Speed Continuous Service**

**2 HP. TO 200 HP. AND HIGHER      2 AND 3-PHASE      25, 40, 50 AND 60 CYCLES**  
**110, 220, 440, 550, AND 2200 VOLTS**

By varying the external resistance on a wound-rotor motor a condition can be created which will parallel any of the various classes of squirrel-cage motors described, so that the speed torque characteristics of a wound-rotor motor are governed entirely by the operation of the control which is used in connection with it. The distinction between types CW and CI motors is that the former is wound for continuous operation and has relatively lower torque and iron loss. The type CI motor is rated on an intermittent basis and is wound for the maximum torque consistent with its mechanical



10 HP. TYPE CW MOTOR



50 HP. TYPE CW MOTOR

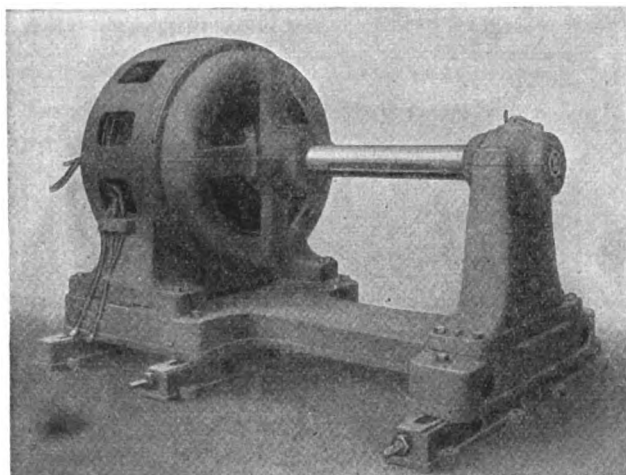
Westinghouse type CW wound-rotor induction motors are designed for both constant and varying speed, continuous duty service. Heavy starting torque with low starting current is obtained by inserting resistance in the rotor circuit when starting the motor. For constant speed service this resistance is cut out by means of a starter furnished with the motor.

For varying speed service a controller with resistance is furnished to obtain continuous operation on any running point from one-half to full-load speed for both blower and constant torque service.

strength and is given a rating which it will carry for one-half hour with 50 degrees Centigrade rise. As compared with the type CW, its torques and iron losses are relatively higher.

Type CW motors are employed for constant speed work where starting conditions are too severe for squirrel-cage motors or where starting is frequent and where good all day running conditions under load are a consideration.

These motors find extensive application where it is necessary to bring up to speed loads requiring heavy starting torque on power lines where generator capacity is limited or where good voltage regulation is imperative. They are suitable for driving plunger pumps, compressors, positive pressure blowers, hoists requiring a continuous duty motor, and in shops where many machines are driven by one motor through long line shafts.



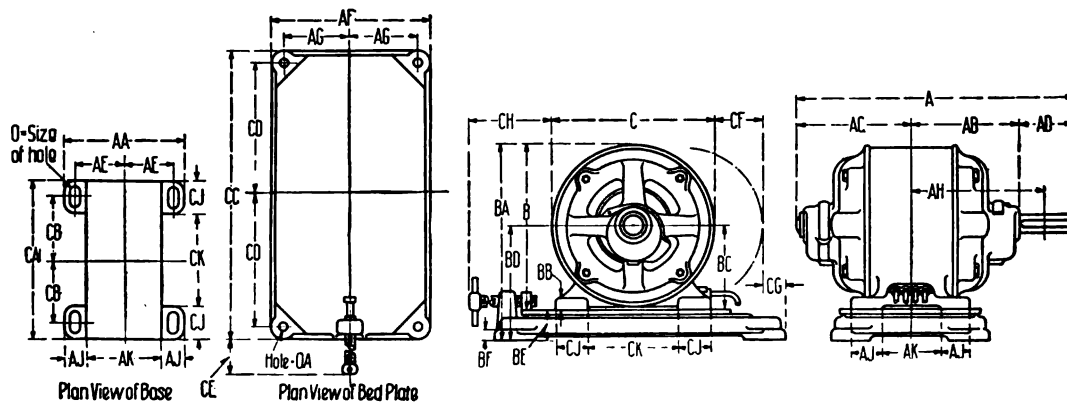
THREE-BEARING TYPE CW MOTOR

POLYPHASE INDUCTION MOTORS—Continued

RATINGS AND OUTLINE DIMENSIONS  
TYPE CSA SQUIRREL-CAGE MOTORS

Hp.	Approx. Rpm. at Full Load	Poles	Frame No.	PAPER PULLEYS††		Hp.	Approx. Rpm. at Full Load	Poles	Frame No.	PAPER PULLEYS††	
				Standard Diam. x Face	Special†† Diam. x Face					Standard Diam. x Face	Special†† Diam. x Face
<b>60-Cycle, 110-220-440-550 Volts§</b>											
1/4	1750	4	643	3 x 1 1/4	1 1/4 x 2	1	1160	6	863	3 1/2 x 3	3 x 4
1/2	3450	2	623	3 x 1 1/4	1 1/4 x 2	1	870	8	863	3 1/2 x 3	3 x 4
3/4	1750	4	743	3 1/2 x 2 1/2	2 1/4 x 3 1/2	1 1/2	1750	4	843	3 1/2 x 3	3 x 4
1	1160	6	763	3 1/2 x 2 1/2	2 1/4 x 3 1/2	1 1/2	1160	6	866	4 x 3 3/4	2 1/4 x 4 1/2
1 1/2	870	8	765	3 1/2 x 2 1/2	3 x 3 1/2	1 1/2	870	8	866	4 x 3 3/4	2 1/4 x 4 1/2
2	1750	4	743	3 1/2 x 2 1/2	2 1/4 x 3 1/2	2	3450	2	823	3 1/2 x 3	3 x 4
3	1160	6	765	3 1/2 x 2 1/2	3 x 3 1/2	2	1750	4	843	3 1/2 x 3	3 x 4
4	870	8	743	3 1/2 x 3	3 x 4	3	1160	6	866	4 x 3 3/4	2 1/4 x 4 1/2
5	3450	2	723	3 1/2 x 3	3 x 4	3	3450	2	827	4 x 3 3/4	2 1/4 x 4 1/2
6	1750	4	745	3 1/2 x 2 1/2	3 x 3 1/4	3	1750	4	846	4 x 3 3/4	2 1/4 x 4 1/2

<b>25-Cycle, 110-220-440-550 Volts§</b>											
1/4	1450	2	725	3 1/2 x 2 1/2	2 1/4 x 3 1/4	1	1450	2	825	3 1/2 x 3	2 1/4 x 4
1/2	715	4	843	3 1/2 x 3	2 1/4 x 4	1	715	4	846	4 x 3 3/4	2 1/4 x 4 1/2



DIMENSIONS IN INCHES

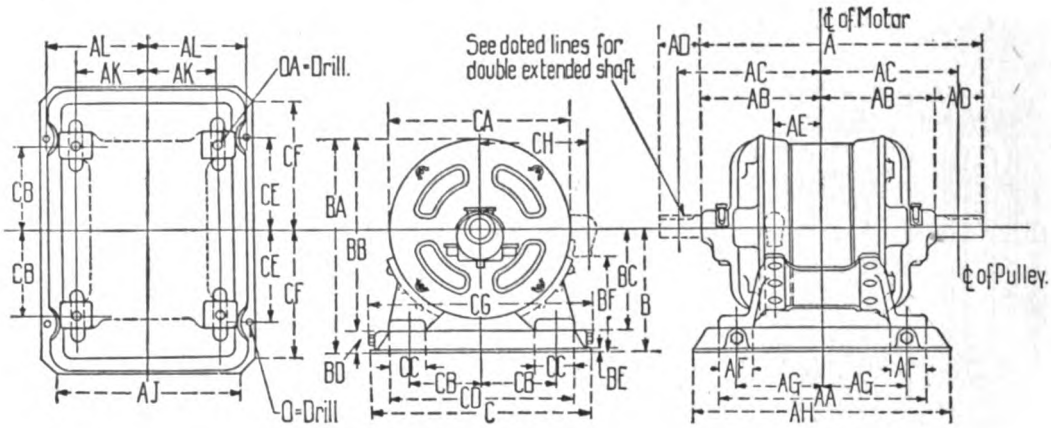
Ref. No.	Frame No.	KEYWAY				Shaft Diam.	A	AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK	B	BA	BB	BC
		Width	Depth	Length	†		†	†	†	†	†	†	†	†	†	†	†	†	†	†	†
I	623*-643*-663*	3/8	1/8	1	5/8	9 3/8	4 1/2	3 1/4	4 1/2	1 1/2	1 7/8	5 7/8	2 1/4	4 1/2	1 3/4	1 3/4	7 3/8	8 3/8	1 1/2	3 1/4	
II	723-743-763	3/8	1/8	1 1/8	3/4	11 1/2	5 1/4	4 3/4	4 1/2	2 1/4	2 1/8	7 1/4	3	5 1/2	1 3/4	1 3/4	8 3/8	10 3/8	1 1/2	4 5/8	
III	725-745-765	3/8	1/8	1 1/8	3/4	12 1/2	6	5 3/8	5 1/2	2 1/4	2 1/2	7 1/4	3	6 1/4	1 3/4	1 3/4	8 3/8	10 3/8	1 1/2	4 5/8	
IV	823-843-863	3/8	1/8	2 3/8	7/8	14 1/2	6 3/8	5 3/4	5 1/2	2 3/4	2 3/4	8 3/4	3 3/4	7 1/4	2	2 5/8	10 1/2	11 1/2	1 1/2	5 3/8	
V	825-845-865	3/8	1/8	2 3/8	7/8	15 1/2	7 3/8	6 1/4	6 1/2	2 3/4	3 1/4	8 3/4	3 3/4	7 3/4	2	3 5/8	10 1/2	11 1/2	1 1/2	5 3/8	
VI	827	3/8	1/8	3 3/8	1 1/8	18 1/2	7 3/8	7 3/8	7 3/8	3 3/4	3 3/4	10	4 1/4	9 3/8	2	3 5/8	10 1/2	12 1/2	1 1/2	5 3/8	
VII	846-866	3/4	1/4	3 3/8	1 1/2	17 3/8	7 3/8	6 3/8	7 1/8	3 3/8	3 1/2	10	4 1/4	9	2	3 5/8	10 1/2	12 1/2	1 1/2	5 3/8	

Ref. No.	Frame No.	BD	BE	BF	C	CA	CB	CC	CD	CE	CF	CG	CH	CJ	CK	O		OA	APPROX. NET WT. LBS.		Style No. of Base
																Lgth	Width		Bare Motor	Add for Sliding Base	
I	623*-643*-663*	4 1/8	7 3/8	3/8	7	7	2 7/8	9 3/4	4 1/2	1 1/4	1 1/4	3 1/2	2 1/2	1 3/4	4 1/2	3/8	3/8	3 1/2	25	5	184554
II	723-743-763	6 1/8	1 1/2	3/8	8 5/8	8 1/2	3 3/8	13 3/4	6 1/4	2 1/2	2	1 1/4	4 3/8	1 3/4	5	1 1/8	3/8	4 1/2	41	12	310272
III	725-745-765	6 1/8	1 1/2	3/8	8 5/8	8 1/2	3 3/8	13 3/4	6 1/4	2 1/2	2	1 1/4	4 3/8	1 3/4	5	1 1/8	3/8	4 1/2	48	12	310272
IV	823-843-863	6 7/8	1 1/2	3/8	10 1/8	9 7/8	3 3/8	15	6 7/8	2 1/2	2	1 3/8	4 1/2	2	5 7/8	1 3/8	3/8	4 1/2	68	23	188502
V	825-845-865	6 7/8	1 1/2	3/8	10 1/8	9 7/8	3 3/8	15	6 7/8	2 1/2	2	1 3/8	4 1/2	2	5 7/8	1 3/8	3/8	4 1/2	76	23	188502
VI	827	7 3/8	1 1/2	3/8	10 1/8	9 7/8	3 3/8	18 1/2	8 1/2	3 3/8	2 1/2	1 3/8	6 1/2	2	5 7/8	1 3/8	3/8	4 1/2	105	30	245766
VII	846-866	7 3/8	1 1/2	3/8	10 1/8	9 7/8	3 3/8	18 1/2	8 1/2	3 3/8	2 1/2	1 3/8	6 1/2	2	5 7/8	1 3/8	3/8	4 1/2	97	30	245766

\*This motor has grease cup lubrication, and leads are brought out through bushings to top of bracket; not shown in cut.  
 †Maximum travel on base.  
 ‡This dimension will never be exceeded but may vary to 1/16-inch less than shown in table. †Approximate.  
 ††Dimensions specified are in inches and refer to the diameter and face respectively.  
 ‡All voltages are for either 2 or 3 phase, except 550 volts which is for 3 phase.  
 ‡We will not under any circumstance guarantee motors if operated with pulleys smaller than those listed in this column.  
 Above dimensions are for reference only. For official dimensions refer to our nearest district office.

POLYPHASE INDUCTION MOTORS—Continued

**OUTLINE DIMENSIONS**  
**TYPE CS TWO-BEARING MOTORS**  
**Frame Classes 200-C and 300-C**



**DIMENSIONS IN INCHES**

Ref. No.	Frame No.	Shaft Diam.	KEYWAY			Max. Travel on Bed Plate	A	AA	AB	AC	AD	AE
			Width	Depth	Length							
I	230-C to 239-C	1 1/4	3/8	1/8	2 3/8	3	20 3/8	12 3/4	8 1/4	10 3/8	3 3/8	2 1/4
II	240-C to 249-C	1 1/2	3/8	1/8	2 3/8	3	21 3/8	12 3/4	8 3/4	10 3/8	3 3/8	2 1/4
III	250-C to 259-C	1 3/4	3/8	1/8	2 3/8	3	22 3/8	14 3/4	9 1/4	11 3/8	3 3/8	3 1/4
IV	340-C to 349-C	1 5/8	3/8	1/8	4 1/8	4	24 1/8	14	9 1/2	12 3/8	5 3/8	3 3/8
V	350-C to 359-C	1 5/8	3/8	1/8	4 1/8	4	25 1/8	14	10 1/2	12 3/8	5 3/8	4 1/8
VI	360-C to 369-C	1 5/8	3/8	1/8	4 1/8	4	26 1/8	16	10 1/2	13 3/8	5 3/8	4 1/8
VII	370-C to 379-C	1 5/8	3/8	1/8	4 1/8	4	27 1/8	16	11 1/2	13 3/8	5 3/8	4 1/8

Ref. No.	Frame No.	AF	AG	AH	AJ	AK	AL	B*	BA	BB	BC	BD	BE
I	230-C to 239-C	2	5 3/8	16 1/4	14	5 3/8	7 3/8	7 1/8	13 3/4	12 1/4	6 1/4	1 3/4	3/8
II	240-C to 249-C	2	5 3/8	16 1/4	14	5 3/8	7 3/8	7 1/8	13 3/4	12 1/4	6 1/4	1 3/4	3/8
III	250-C to 259-C	2	6 3/8	18 1/4	16	6 3/8	8 3/8	7 1/8	13 3/4	12 1/4	6 1/4	1 3/4	3/8
IV	340-C to 349-C	2	6	18 1/4	15 1/4	6	8 1/8	9 3/8	16 1/8	14 1/4	7 3/8	1 3/8	3/8
V	350-C to 359-C	2	6	18 1/4	15 1/4	6	8 1/8	9 3/8	16 1/8	14 1/4	7 3/8	1 3/8	3/8
VI	360-C to 369-C	2	7	20 1/4	17 1/4	7	9 1/8	9 3/8	16 1/8	14 1/4	7 3/8	1 3/8	3/8
VII	370-C to 379-C	2	7	20 1/4	17 1/4	7	9 1/8	9 3/8	16 1/8	14 1/4	7 3/8	1 3/8	3/8

Ref. No.	Frame No.	BF	C	CA	CB	CC	CD	CE	CF	CG	CH	O	OA
I	230-C to 239-C	5 1/4	19 1/4	11 3/8	5 1/4	2 3/8	13 1/2	5 3/4	8 1/2	19 3/8	7 3/8	1 3/8	1 1/8
II	240-C to 249-C	5 1/4	19 1/4	11 3/8	5 1/4	2 3/8	13 1/2	5 3/4	8 1/2	19 3/8	7 3/8	1 3/8	1 1/8
III	250-C to 259-C	5 1/4	19 1/4	11 3/8	5 1/4	2 3/8	13 1/2	5 3/4	8 1/2	19 3/8	7 3/8	1 3/8	1 1/8
IV	340-C to 349-C	6 3/4	23	13 3/8	6 1/4	3 1/8	16	7	10	23 3/8	8 1/8	3 3/8	1 1/8
V	350-C to 359-C	6 3/4	23	13 3/8	6 1/4	3 1/8	16	7	10	23 3/8	8 1/8	3 3/8	1 1/8
VI	360-C to 369-C	6 3/4	23	13 3/8	6 1/4	3 1/8	16	7	10	23 3/8	8 1/8	3 3/8	1 1/8
VII	370-C to 379-C	6 3/4	23	13 3/8	6 1/4	3 1/8	16	7	10	23 3/8	8 1/8	3 3/8	1 1/8

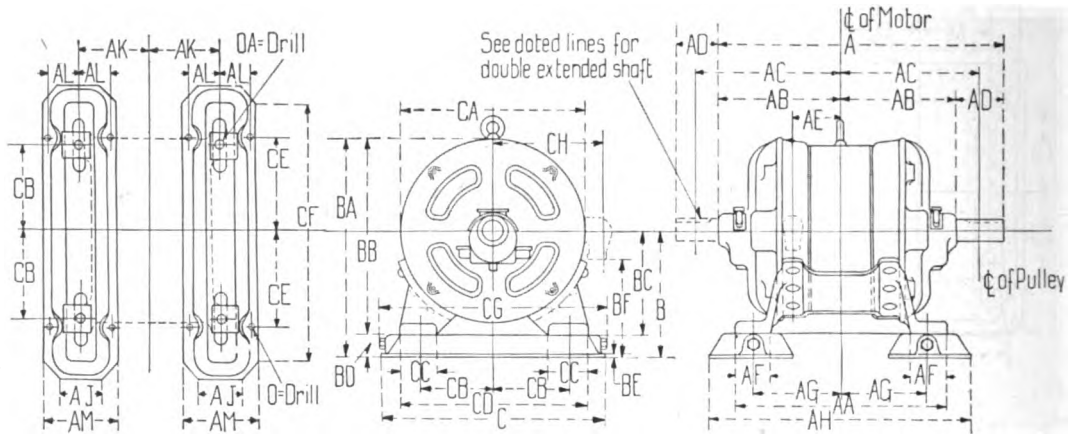
\*This dimension will never be exceeded. Above dimensions are for reference only. For official dimensions refer to our nearest district office.

POLYPHASE INDUCTION MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CS TWO-BEARING MOTORS

Frame Classes 400-C and D and 500-C



DIMENSIONS IN INCHES

Ref. No.	Frame No.	Shaft Diam.	KEYWAY			Max. Travel on Bed Plate	A	AA	AB	AC	AD	AE	AF
			Width	Depth	Length								
I	460-C to 469-C	1 7/8	3/8	3/8	5 3/8	4 1/2	33 3/8	16 1/2	13 3/8	16 3/8	6 3/8	4 1/8	2
II	470-C to 479-C	1 3/4	3/8	3/8	5 3/8	4 1/2	34 3/8	16 1/2	13 3/8	17 3/8	6 3/8	4 1/8	2 1/4
III	480-C to 489-C	1 7/8	3/8	3/8	5 3/8	4 1/2	35 3/8	18 1/2	14 3/8	17 3/8	6 3/8	5 1/8	2
IV	480-C to 489-D	2 3/8	3/8	3/8	6 3/8	4 1/2	39 1/2	18 1/2	15 3/4	19 3/4	8	5 3/8	2
V	560-C to 569-C	2 3/8	3/8	3/8	6 3/8	5 1/2	38 1/8	17 3/8	15 1/8	19 3/8	8	4 3/8	2
VI	580-C to 589-C	2 3/8	3/8	3/8	6 3/8	5 1/2	40 1/8	19 3/8	16 1/8	20 3/8	8	5 3/8	2

Ref. No.	Frame No.	AG	AH	AJ	AK	AL	AM	B*	BA	BB	BC	BD	BE
I	460-C to 469-C	7 1/8	21 1/8	3 3/8	7 1/8	2 3/4	6 7/8	11	19 3/8	17 3/8	9	2	1 1/4
II	470-C to 479-C	7 3/8	21 3/8	3 3/8	7 3/8	2 3/4	6 7/8	11	19 3/8	17 3/8	9	2	1 1/4
III	480-C to 489-C	8 1/8	23 1/8	3 3/8	8 1/8	2 3/4	6 7/8	11	19 3/8	17 3/8	9	2	1 1/4
IV	480-D to 489-D	8 3/8	23 3/8	3 3/8	8 3/8	2 3/4	6 7/8	11	19 3/8	17 3/8	9	2	1 1/4
V	560-C to 569-C	7 1/2	22 3/4	4 3/8	7 1/2	3 1/8	7 3/4	13 1/8	23 3/8	20 3/8	10 3/4	2 3/8	3/8
VI	580-C to 589-C	8 1/2	24 3/4	4 3/8	8 1/2	3 1/8	7 3/4	13 1/8	23 3/8	20 3/8	10 3/4	2 3/8	3/8

Ref. No.	Frame No.	BF	C	CA	CB	CC	CD	CE	CF	CG	CH	O	OA
I	460-C to 469-C	7	27 1/8	17 1/4	7 1/2	3 3/8	19 1/4	8 3/8	23 3/8	27 1/4	10 1/2	3/4	1 1/2
II	470-C to 479-C	7	27 3/8	17 1/4	7 3/2	3 3/8	19 1/4	8 3/8	23 3/8	27 1/4	10 1/2	3/4	1 1/2
III	480-C to 489-C	7	27 1/8	17 1/4	7 1/2	3 3/8	19 1/4	8 3/8	23 3/8	27 1/4	10 1/2	3/4	1 1/2
IV	480-D to 489-D	7	27 3/8	17 1/4	7 3/2	3 3/8	19 1/4	8 3/8	23 3/8	27 1/4	10 1/2	3/4	1 1/2
V	560-C to 569-C	9 1/8	33	20 3/8	9 1/4	4	23 1/8	11 1/8	29 3/8	33 1/4	12 1/4	7/8	1 1/2
VI	580-C to 589-C	9 1/8	33	20 3/8	9 1/4	4	23 1/8	11 1/8	29 3/8	33 1/4	12 1/4	7/8	1 1/2

\*This dimension will never be exceeded. Above dimensions are for reference only. For official dimensions refer to our nearest district office.

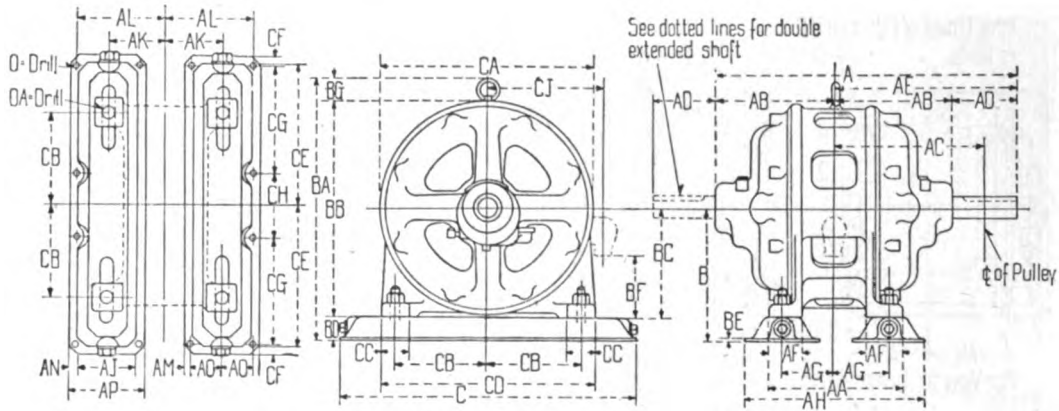


POLYPHASE INDUCTION MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CS TWO-BEARING MOTORS

Frame Classes 600-B and C, 700-B and C, 800-C



DIMENSIONS IN INCHES

Ref. No.	Frame No.	Shaft Diam.	KEYWAY			Max. Travel on Rails	A	AA	AB	AC	AD	AE	AF	AG	AH
			Width	Depth	Length										
I	640-B to 649-B	2 3/8	3/8	3/16	6 1/2	39 3/8	18 1/2	15 3/8	20 3/8	8	23 3/8	4 3/8	7 3/8	24 3/8	
II	640-C to 649-C	2 7/8	3/8	3/16	6 1/2	44 1/8	18 1/2	17 3/8	22 3/8	9 1/2	26 3/8	4 3/8	7 3/8	24 3/8	
III	650-B to 659-B	2 3/4	3/8	3/16	6 7/8	41 3/8	20 3/8	16 3/8	21 3/8	8	24 3/8	4 3/8	8 3/8	26 3/8	
IV	650-C to 659-C	2 7/8	3/8	3/16	6 7/8	46 1/8	20 3/8	18 3/8	23 3/8	9 1/2	27 3/8	4 3/8	8 3/8	26 3/8	
V	660-C to 669-C	2 7/8	3/8	3/16	8 1/4	48 3/8	20 3/8	19 3/8	24 3/8	9 3/4	28 3/8	4 3/8	9 3/4	28 3/8	
VI	750-B to 759-B	2 7/8	3/8	3/16	8 3/4	45 3/8	21 3/8	17 3/8	23 3/8	9 3/4	27 3/8	5 3/8	8 3/8	27	
VII	750-C to 759-C	3 3/8	3/8	3/16	8 3/4	48 3/8	21 3/8	19 3/8	26 3/8	10 1/4	29 3/8	5 3/8	8 3/8	27	
VIII	760-B to 769-B	2 7/8	3/8	3/16	8 1/4	47 3/8	23 3/8	18 3/8	24 3/8	9 3/4	28 3/8	5 3/8	9 3/4	29	
IX	760-C to 769-C	3 3/8	3/8	3/16	8 3/4	50 3/8	23 3/8	20 3/8	27 3/8	10 1/4	30 3/8	5 3/8	9 3/4	29	
X	770-C to 779-C	3 3/8	3/8	3/16	8 3/4	52 3/8	25 3/8	21 3/8	28 3/8	10 1/4	31 3/8	5 3/8	10 3/8	31	
XI	850-C to 859-C	3 1/2	3/8	3/16	12	53 3/8	22 3/8	19 3/8	27 3/8	13 3/8	33 3/8	6 1/4	9 3/8	30 3/4	
XII	870-C to 879-C	3 1/2	3/8	3/16	12	57 3/8	26 3/8	21 3/8	29 3/8	13 3/8	35 3/8	6 1/4	11 3/8	34 3/4	

Ref. No.	Frame No.	AJ	AK	AL	AM	AN	AO	AP	B†	BA	BB	BC	BD	BE	BF
I	640-B to 649-B	8 1/2	7 3/4	12 1/2	7/8	3/8	3 3/4	9 1/4	16 3/8	32 3/8	25 1/2	13	3 3/8	7/8	4 1/2
II	640-C to 649-C	8 3/4	7 3/4	12 1/2	7/8	3/8	3 3/4	9 1/4	16 3/8	32 3/8	25 1/2	13	3 3/8	7/8	4 1/2
III	650-B to 659-B	8 3/4	8 3/4	13 1/2	7/8	3/8	3 3/4	9 1/4	16 3/8	32 3/8	25 1/2	13	3 3/8	7/8	4 1/2
IV	650-C to 659-C	8 3/4	8 3/4	13 1/2	7/8	3/8	3 3/4	9 1/4	16 3/8	32 3/8	25 1/2	13	3 3/8	7/8	4 1/2
V	660-C to 669-C	8 3/4	9 3/4	14 1/2	7/8	3/8	3 3/4	9 1/4	16 3/8	32 3/8	25 1/2	13	3 3/8	7/8	4 1/2
VI	750-B to 759-B	8 3/4	8 7/8	12 3/8	7/8	3/8	3 3/4	9 1/4	18 3/8	37 3/8	29 3/8	15 1/2	3 3/8	7/8	6 3/8
VII	750-C to 759-C	8 3/4	8 7/8	12 3/8	7/8	3/8	3 3/4	9 1/4	18 3/8	37 3/8	29 3/8	15 1/2	3 3/8	7/8	6 3/8
VIII	760-B to 769-B	8 3/4	9 3/8	13 3/8	7/8	3/8	3 3/4	9 1/4	18 3/8	37 3/8	29 3/8	15 1/2	3 3/8	7/8	6 3/8
IX	760-C to 769-C	8 3/4	9 3/8	13 3/8	7/8	3/8	3 3/4	9 1/4	18 3/8	37 3/8	29 3/8	15 1/2	3 3/8	7/8	6 3/8
X	770-C to 779-C	8 3/4	10 3/8	14 3/8	7/8	3/8	3 3/4	9 1/4	18 3/8	37 3/8	29 3/8	15 1/2	3 3/8	7/8	6 3/8
XI	850-C to 859-C	10	9 1/4	14 3/4	1	1 1/4	5 1/4	12 1/2	21 3/4	43 3/4	34 3/4	17 3/4	4	1 1/2	8 1/2
XII	870-C to 879-C	10	11 1/8	16 3/8	1	1 1/4	5 1/4	12 1/2	21 3/4	43 3/4	34 3/4	17 3/4	4	1 1/2	8 1/2

Ref. No.	Frame No.	BG	C	CA	CB	CC	CD	CE	CF	CG	CH	CJ	O	OA
I	640-B to 649-B	4 1/4	25	11	3 3/4	26 1/2	19 3/8	7/8	15	8 3/4	16 3/8	7/8	1 3/4	
II	640-C to 649-C	4 1/4	40 1/2	25	11	3 3/4	26 1/2	19 3/8	7/8	15	16 3/8	7/8	1 3/4	
III	650-B to 659-B	4 1/4	25	11	3 3/4	26 1/2	19 3/8	7/8	15	8 3/4	16 3/8	7/8	1 3/4	
IV	650-C to 659-C	4 1/4	40 1/2	25	11	3 3/4	26 1/2	19 3/8	7/8	15	16 3/8	7/8	1 3/4	
V	660-C to 669-C	4 1/4	40 1/2	25	11	3 3/4	26 1/2	19 3/8	7/8	15	16 3/8	7/8	1 3/4	
VI	750-B to 759-B	4 7/8	29 3/8	12 3/4	4 1/2	31	19 3/8	7/8	15	8 3/4	19	7/8	1 3/4	
VII	750-C to 759-C	4 7/8	40 1/2	29 3/8	12 3/4	4 1/2	31	19 3/8	7/8	15	19	7/8	1 3/4	
VIII	760-B to 769-B	4 7/8	29 3/8	12 3/4	4 1/2	31	19 3/8	7/8	15	8 3/4	19	7/8	1 3/4	
IX	760-C to 769-C	4 7/8	40 1/2	29 3/8	12 3/4	4 1/2	31	19 3/8	7/8	15	19	7/8	1 3/4	
X	770-C to 779-C	4 7/8	40 1/2	29 3/8	12 3/4	4 1/2	31	19 3/8	7/8	15	19	7/8	1 3/4	
XI	850-C to 859-C	4 3/8	49 1/4	34 1/4	15 3/8	5	36 1/2	23 1/2	1 3/8	17 3/8	10 1/2	21 3/8	1 3/4	
XII	870-C to 879-C	4 3/8	49 1/4	34 1/4	15 3/8	5	36 1/2	23 1/2	1 3/8	17 3/8	10 1/2	21 3/8	1 3/4	

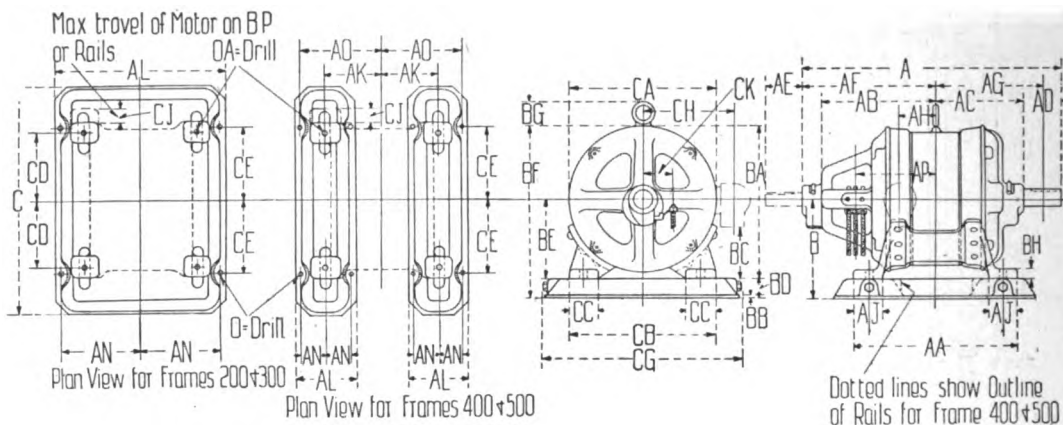
†This dimension will never be exceeded. Above dimensions are for reference only. For official dimensions refer to our nearest district office.

POLYPHASE INDUCTION MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CW WOUND-ROTOR MOTORS

Frame Classes 200-C to 500-C



DIMENSIONS IN INCHES

Ref. No.	Frame No.	PULLEY END			OPPOSITE END				Shaft tolerance	A	AA	AB	AC	AD	AE	AF	AG	AH	
		Shaft Dia.	KEYWAY		Shaft Dia.	KEYWAY													
		Wid	Dep	Lth.	Wid	Dep	Lth.												
I	230-C to 239-C	1 1/4	3/8	1/8	2 3/8	1 1/4	3/8	1/8	2 3/8	+ .000 - .001	26	12 3/4	11 3/8	8 1/4	3 3/8	3 3/8	13 3/8	10 3/8	2 7/8
II	250-C to 259-C	1 1/4	3/8	1/8	2 3/8	1 1/4	3/8	1/8	2 3/8	+ .000 - .001	28	14 3/4	12 3/8	9 1/4	3 3/8	3 3/8	14 3/8	11 3/8	3 3/8
III	340-C to 349-C	1 5/8	3/8	1/8	4 1/2	...	...	...	...	+ .000 - .001	31 1/2	14	13 3/4	9 3/4	5 1/2	...	16 1/2	12 3/8	3 3/8
IV	350-C to 359-C	1 5/8	3/8	1/8	4 1/2	...	...	...	...	+ .000 - .001	32 3/8	14	14 1/4	10 3/8	5 1/2	...	16 1/2	12 3/8	3 3/8
V	360-C to 369-C	1 5/8	3/8	1/8	4 1/2	...	...	...	...	+ .000 - .001	33 1/2	16	14 3/4	10 3/8	5 1/2	...	17 1/2	13 3/8	4 3/8
VI	370-C to 379-C	1 5/8	3/8	1/8	4 1/2	...	...	...	...	+ .000 - .001	34 1/2	16	15 1/4	11 3/8	5 1/2	...	17 1/2	13 3/8	4 3/8
VII	470-C to 479-C	1 3/8	3/8	3/8	5 3/8	1 5/8	3/8	1/8	5 3/8	+ .000 - .001	39 3/8	16 1/2	16 3/8	13 3/8	6 3/8	6 3/8	18 3/8	17 3/8	4 3/8
VIII	480-C to 489-C	1 3/8	3/8	3/8	5 3/8	1 5/8	3/8	1/8	5 3/8	+ .000 - .001	40 3/8	18 1/2	16 3/8	14 3/8	6 3/8	6 3/8	19 3/8	17 3/8	5 3/8
IX	560-C to 569-C	2 3/8	3/8	3/8	6 7/8	1 3/8	3/8	3/8	5 3/4	+ .000 - .001	43 3/8	17 3/8	17 3/8	15 3/8	8	6 3/8	20 1/2	19 3/8	4 3/8
X	580-C to 589-C	2 3/8	3/8	3/8	6 7/8	1 3/8	3/8	3/8	5 3/4	+ .000 - .001	45 3/8	19 3/8	18 3/8	16 3/8	8	6 3/8	21 1/2	20 1/8	5 3/8

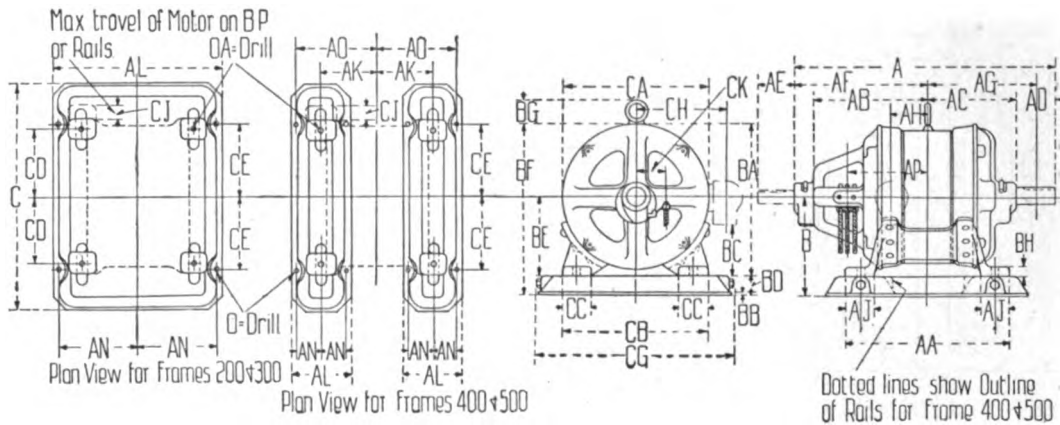
Above dimensions are for reference only. For official dimensions refer to our nearest district office.

POLYPHASE INDUCTION MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CW WOUND-ROTOR MOTORS

Frame Classes 200-C to 500-C



DIMENSIONS IN INCHES

Ref. No.	Frame No.	AJ	AK	AL	AN	AO	AP	B*	BA	BB	BC	BD	BE
I	230-C to 239-C	2	5 3/4	...	7 3/4	13	8 3/4	7 1/2	12 1/2	3/4	3 3/4	1 3/4	6 1/4
II	250-C to 259-C	2	6 3/4	...	8 3/4	15	9 3/4	7 3/4	12 1/2	3/4	3 3/4	1 3/4	6 1/4
III	340-C to 349-C	2	6	18 1/4	8 1/2	14 1/2	10 1/2	9 3/4	14 1/2	3/4	4 3/4	1 3/4	7 3/4
IV	350-C to 359-C	2	6	18 1/4	8 1/2	14 1/2	11	9 3/4	14 1/2	3/4	4 3/4	1 3/4	7 3/4
V	360-C to 369-C	2	7	20 1/4	9 1/2	16 1/2	11 1/2	9 3/4	14 1/2	3/4	4 3/4	1 3/4	7 3/4
VI	370-C to 379-C	2	7	20 1/4	9 1/2	16 1/2	12	9 3/4	14 1/2	3/4	4 3/4	1 3/4	7 3/4
VII	470-C to 479-C	2 1/4	7 1/2	6 3/4	2 3/4	9 3/4	14 1/4	11	17 1/2	1 1/4	5	2	9
VIII	480-C to 489-C	2 1/4	8 1/2	6 3/4	2 3/4	10 3/4	14 1/4	11	17 1/2	1 1/4	5	2	9
IX	560-C to 569-C	2 3/4	7 3/4	7 3/4	3 3/4	10 3/4	15 3/4	13 3/4	20 3/4	3/4	6 3/4	2 3/4	10 3/4
X	580-C to 589-C	2 3/4	8 3/4	7 3/4	3 3/4	11 3/4	16 3/4	13 3/4	20 3/4	3/4	6 3/4	2 3/4	10 3/4

Ref. No.	Frame No.	BF	BG	C	CA	CB	CC	CD	CE	CF	CG	CH	CJ†	CK	O	OA	Style No. of Rails or Bed-plate
I	230-C to 239-C	1 3/4	3/8	19 1/4	11 3/4	13 1/2	2 3/4	5 1/4	5 3/4	17	19 3/4	7 3/8	3	5 1/2	1/2	1 1/2	297555
II	250-C to 259-C	1 3/4	3/8	19 1/4	11 3/4	13 1/2	2 3/4	5 1/4	5 3/4	17	19 3/4	7 3/8	3	5 1/2	1/2	1 1/2	297556
III	340-C to 349-C	16 3/4	3/8	23	14 1/4	16	3 3/4	6 1/4	7	20	23 3/4	8 3/8	4	6 1/2	3/4	1 1/2	297559
IV	350-C to 359-C	16 3/4	3/8	23	14 1/4	16	3 3/4	6 1/4	7	20	23 3/4	8 3/8	4	6 1/2	3/4	1 1/2	297559
V	360-C to 369-C	16 3/4	3/8	23	14 1/4	16	3 3/4	6 1/4	7	20	23 3/4	8 3/8	4	6 1/2	3/4	1 1/2	297560
VI	370-C to 379-C	16 3/4	3/8	23	14 1/4	16	3 3/4	6 1/4	7	20	23 3/4	8 3/8	4	6 1/2	3/4	1 1/2	297560
IX	470-C to 479-C	19 3/4	3/4	27 1/2	17 1/4	19 1/4	3 3/4	7 1/2	8 3/4	23 3/4	27 1/4	10 1/2	4 1/2	5 3/4	3/4	1 1/2	297562
X	480-C to 489-C	19 3/4	3/4	27 1/2	17 1/4	19 1/4	3 3/4	7 1/2	8 3/4	23 3/4	27 1/4	10 1/2	4 1/2	5 3/4	3/4	1 1/2	297562
XII	560-C to 569-C	23 3/4	3/4	33	20 3/4	23 1/4	4	9 1/4	11 1/4	29 3/4	33 1/4	12 1/4	5 1/2	6 3/4	3/4	1 1/2	297565
XIII	580-C to 589-C	23 3/4	3/4	33	20 3/4	23 1/4	4	9 1/4	11 1/4	29 3/4	33 1/4	12 1/4	5 1/2	6 3/4	3/4	1 1/2	297565

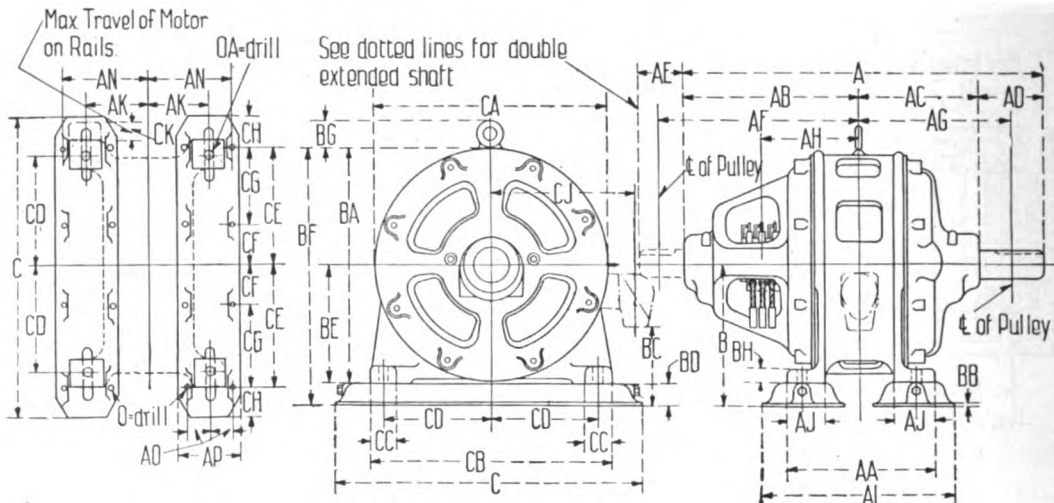
\*This dimension will never be exceeded. When exact dimension is required, liners up to 1/16-inch may be necessary.  
 †Maximum travel of motor on rails or bed-plate.  
 Above dimensions are for reference only. For official dimensions refer to our nearest district office.

POLYPHASE INDUCTION MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CW WOUND-ROTOR MOTORS

Frame Classes 600-C and D, 700-C and D, and 800-C and D



DIMENSIONS IN INCHES

Ref. No.	Frame No.	PULLEY END			OPPOSITE END				A	AA	AB	AC	AD	AE	AF	AG	
		Shaft Dia.	KEYWAY			Shaft Dia.	KEYWAY										
			Wid.	Dep.	Lth.		Wid.	Dep.									Lth.
I	640-C to 649-C	2 7/8	3/8	1/4	8 1/4	2 3/8	3/8	3/8	6 7/8	50 3/8	18 1/2	23 3/8	17 3/8	9 3/8	8	27 3/8	22 3/8
II	650-C to 659-C	2 7/8	3/8	1/4	8 1/4	2 3/8	3/8	3/8	6 7/8	52 3/8	20 1/2	24 3/8	18 3/8	9 3/8	8	28 3/8	23 3/8
III	650-D to 659-D	2 7/8	3/8	1/4	8 1/4	2 3/8	3/8	3/8	6 7/8	55 3/8	20 1/2	24 3/8	20 3/8	10 1/4	8	28 3/8	25 3/8
IV	660-C to 669-C	2 7/8	3/8	1/4	8 1/4	2 3/8	3/8	3/8	6 7/8	54 3/8	22 1/2	25 3/8	19 3/8	9 3/8	8	29 3/8	24 3/8
V	750-C to 759-C	3 3/8	3/8	3/8	8 3/8	2 7/8	3/8	1/4	8 1/4	56 3/8	21 1/4	27 1/4	19 3/8	10 1/4	9 1/2	32	24 3/8
VI	760-C to 769-C	3 3/8	3/8	3/8	8 7/8	2 7/8	3/8	1/4	8 1/4	58 3/8	23 1/4	28 1/4	20 3/8	10 1/4	9 1/2	33	25 3/8
VII	770-C to 779-C	3 3/8	3/8	3/8	8 7/8	2 7/8	3/8	1/4	8 1/4	60 3/8	25 1/4	29 1/4	21 3/8	10 1/4	9 1/2	34	26 3/8
VIII	850-C to 859-C	3 3/8	3/8	3/8	12	3 3/8	3/8	3/8	10 3/4	62	22 1/2	28 3/8	19 3/8	13 1/2	12	33 3/8	26 3/8
IX	860-C to 869-C	3 3/8	3/8	3/8	12	3 3/8	3/8	3/8	10 3/4	64	24 1/2	29 3/8	20 3/8	13 1/2	12	34 3/8	27 3/8
X	870-C to 879-C	3 3/8	3/8	3/8	12	3 3/8	3/8	3/8	10 3/4	66	26 1/2	30 3/8	21 3/8	13 1/2	12	35 3/8	28 3/8

Ref. No.	Frame No.	AH	AJ	AK	AL	AN	AO	AP	B*	BA	BB	BC	BD	BE	BF	BG	BH
I	640-C to 649-C	14 1/2	4 3/4	7 3/4	24 3/4	17	3 3/8	9 1/4	16 3/8	25 3/8	7/8	7 3/8	3 3/8	13	28 3/8	7 3/8	1 3/8
II	650-C to 659-C	15 1/2	4 3/4	8 3/4	26 3/4	18	3 3/8	9 1/4	16 3/8	25 3/8	7/8	7 3/8	3 3/8	13	28 3/8	7 3/8	1 3/8
III	650-D to 659-D	15 1/2	4 3/4	8 3/4	26 3/4	18	3 3/8	9 1/4	16 3/8	25 3/8	7/8	7 3/8	3 3/8	13	28 3/8	7 3/8	1 3/8
IV	660-C to 669-C	16 1/2	4 3/4	9 3/4	28 3/4	19	3 3/8	9 1/4	16 3/8	25 3/8	7/8	7 3/8	3 3/8	13	28 3/8	7 3/8	1 3/8
V	750-C to 759-C	19 1/4	5 3/8	8 3/8	27	18 1/2	3 3/8	9 1/4	18 3/8	29 3/8	7/8	9 1/2	3 3/8	15 1/4	33 3/8	9 1/2	1 3/8
VI	760-C to 769-C	20 1/4	5 3/8	9 3/8	29	19 1/2	3 3/8	9 1/4	18 3/8	29 3/8	7/8	9 1/2	3 3/8	15 1/4	33 3/8	9 1/2	1 3/8
VII	770-C to 779-C	19 3/4	5 3/8	10 3/8	31	20 3/8	3 3/8	9 1/4	18 3/8	29 3/8	7/8	9 1/2	3 3/8	15 1/4	33 3/8	9 1/2	1 3/8
VIII	850-C to 859-C	17 1/2	6 1/4	9 1/4	30 3/4	21 3/8	5 1/4	12 1/2	21 3/4	34 1/4	1 1/2	12 1/2	4	17 3/4	38 3/8	12 1/2	2 1/4
IX	860-C to 869-C	18 1/2	6 1/4	10 1/4	32 3/4	22 3/8	5 1/4	12 1/2	21 3/4	34 1/4	1 1/2	12 1/2	4	17 3/4	38 3/8	12 1/2	2 1/4
X	870-C to 879-C	19 1/2	6 1/4	11 1/4	34 3/4	23 3/8	5 1/4	12 1/2	21 3/4	34 1/4	1 1/2	12 1/2	4	17 3/4	38 3/8	12 1/2	2 1/4

Ref. No.	Frame No.	C	CA	CB	CC	CD	CE	CG	CH	CJ	CK	O	OA	Style No. of Slide-Rails
I	640-C to 649-C	40 1/2	25	26 1/2	3 3/4	11	19 3/4	15	7/8	16 3/8	5	3/4	1 3/4	303235
II	650-C to 659-C	40 1/2	25	26 1/2	3 3/4	11	19 3/4	15	7/8	16 3/8	5	3/4	1 3/4	303235
III	650-D to 659-D	40 1/2	25	26 1/2	3 3/4	11	19 3/4	15	7/8	16 3/8	5	3/4	1 3/4	303235
IV	660-C to 669-C	40 1/2	25	26 1/2	3 3/4	11	19 3/4	15	7/8	16 3/8	5	3/4	1 3/4	303235
V	750-C to 759-C	40 1/2	29 3/8	31	4 1/2	12 3/4	19 3/4	15	5/8	19	5	7/8	1 3/4	303236
VI	760-C to 769-C	40 1/2	29 3/8	31	4 1/2	12 3/4	19 3/4	15	5/8	19	5	7/8	1 3/4	303236
VII	770-C to 779-C	40 1/2	29 3/8	31	4 1/2	12 3/4	19 3/4	15	5/8	19	5	7/8	1 3/4	303236
VIII	850-C to 859-C	49 1/2	34 3/4	36 1/2	5	15 3/8	22 7/8	17 3/8	1 1/2	21 3/8	6	1 1/4	1 3/4	303503
IX	860-C to 869-C	49 1/2	34 3/4	36 1/2	5	15 3/8	22 7/8	17 3/8	1 1/2	21 3/8	6	1 1/4	1 3/4	303503
X	870-C to 879-C	49 1/2	34 3/4	36 1/2	5	15 3/8	22 7/8	17 3/8	1 1/2	21 3/8	6	1 1/4	1 3/4	303503

Above dimensions are for reference only. For official dimensions refer to our nearest district office.  
 \*This dimension will never be exceeded.

POLYPHASE INDUCTION MOTORS—Continued

RATINGS

TYPE CS SQUIRREL-CAGE INDUCTION MOTORS

220, 440, 550 Volts, 60 Cycles, 2 and 3-Phase

Hp.	Approx. Rpm at Full Load	Poles	Frame No.	PULLEY DIMENSIONS INCHES		Hp.	Approx. Rpm at Full Load	Poles	Frame No.	PULLEY DIMENSIONS INCHES	
				DIAMETER X FACE						DIAMETER X FACE	
				Standard	Special†					Standard	Special†
2	870	8	234C	4x 4	5 x 4½	30	575	12	750C	12x14	12 x14
3	1160	6	234C	4x 4	4 x 5	40	1750	4	583C	10x 9	7½x12
3	870	8	340C	6x 5	4 x 9	40	1160	6	587C	11x10	10 x12
5	3475	2	233C	*	*	40	870	8	644C	12x12	10 x14
5	1750	4	232C	4x 4	4 x 5	40	690	10	750C	12x14	11 x14
5	1160	6	254C	5x 4½	5 x 5	40	575	12	752C	12x14	12 x14
5	870	8	352C	6x 5	4 x 9	50	1750	4	587C	11x10	*
7½	3475	2	243C	*	*	50	1160	6	642C	12x12	10 x14
7½	1750	4	250C	5x 4½	5 x 5	50	870	8	644C	12x12	11 x14
7½	1160	6	352C	6x 5	4½x 9	50	690	10	752C	12x14	12 x18
7½	690	8	370C	7x 6	5 x10	50	575	12	752C	12x14	12 x18
7½	690	10	460C	8x 7	6 x10	60	1750	4	645C	*	*
7½	575	12	464C	9x 8	6 x10	60	1160	6	644C	12x14	11 x14
10	3475	2	351.5C	*	*	60	870	8	646C	14x12	12 x14
10	1750	4	351C	6x 5	4 x 9	60	690	10	752C	16x13	14 x18
10	1160	6	370C	7x 6	5 x10	60	575	12	754C	18x15	15 x18
10	870	8	460C	8x 7	6 x10	75	1750	4	645C	10x 9	*
10	690	10	480C	8x 7	6 x10	75	1160	6	662C	14x12	13 x14
10	575	12	566C	9x 8	7 x10	75	870	8	752C	14x12	14 x16
15	3475	2	363.5C	10x 9	7 x12	75	690	10	754C	16x13	15 x18
15	1750	4	371C	7x 6	5 x10	75	575	12	774C	18x15	16 x20
15	1160	6	460C	8x 7	8 x 7	100	1750	4	663C	12x12	*
15	870	8	480C	8x 7	8 x 7	100	1160	6	752C	14x12	13 x14
15	690	10	566C	8x 9	8 x 7	100	870	8	754C	16x13	14 x16
15	575	12	582C	10x 9	8 x12	100	690	10	854C	20x15	15 x18
20	3475	2	461.5C	10x 9	9 x12	100	575	12	854C	20x15	16 x20
20	1750	4	461C	8x 7	5½x10	125	1750	4	761C	*	*
20	1160	6	480C	9x 8	7 x10	125	1160	6	760C	*	*
20	870	8	566C	10x 9	7 x12	125	870	8	774C	18x18	18 x18
20	690	10	586C	9x 8	9 x12	125	690	10	856C	25x17	20 x20
20	575	12	642C	11x10	9 x14	125	575	12	874C	25x17	20 x20
25	3475	2	471.5C	*	*	150	1750	4	771.5C	*	*
25	1750	4	471C	8x 7	6 x10	150	1160	6	772C	18x15	*
25	1160	6	567C	10x 9	7 x12	150	870	8	854C	20x15	19 x20
25	870	8	586C	11x10	8 x12	150	690	10	874C	21x17	22 x20
25	690	10	644C	12x10	9 x14	150	575	12	938C	25x17	22 x22
25	575	12	750C	12x14	12 x14	200	1750	4	855C	*	*
30	3475	2	471.5C	*	*	200	1160	6	874C	*	*
30	1750	4	481C	9x 8	7 x10	200	870	8	947A	22x20	20 x22
30	1160	6	567C	10x 9	8 x12	200	690	10	954A	28x18	23 x22
30	870	8	642C	11x10	9 x12	200	575	12	938	25x20	22 x22
30	690	10	644C	12x12	10 x14	...	...	...	...	...	...

\* This rating is not recommended for belted service.  
 † Dimensions given are for minimum diameter and maximum face of special pulley.

POLYPHASE INDUCTION MOTORS—Continued

RATINGS

TYPE CS SQUIRREL-CAGE INDUCTION MOTORS

2220 Volts—60 Cycles—2 and 3-Phase

Hp.	Approx. Rpm. at Full Load	Poles	Frame No.	PULLEY DIMENSIONS INCHES DIAMETER x FACE	
				Standard	Special†
25	1750	4	565C	10x 9	6 x10
25	1160	6	642C	10x 9	7 x12
25	870	8	644C	11x10	9 x12
30	1750	4	565C	10x 9	6 x12
30	1160	6	642C	10x 9	8 x12
30	870	8	644C	11x10	9 x12
30	690	10	750C	12x14	11 x14
40	1750	4	583C	10x 9	7½x12
40	1160	6	642C	11x10	10 x12
40	870	8	652C	12x12	10 x14
40	690	10	750C	12x14	11 x14
50	1750	4	587C	11x10	*
50	1160	6	642C	12x12	10 x14
50	870	8	644C	12x12	11 x14
50	690	10	752C	12x14	12 x18
50	575	12	752C	12x14	12 x18
60	1750	4	653C	*	*
60	1160	6	664C	12x14	11 x14
60	870	8	762C	14x12	12 x14
60	690	10	774C	16x13	12 x15
60	575	12	774C	18x15	15 x18
75	1750	4	653C	10x 9	*
75	1160	6	664C	14x12	13 x14
75	870	8	762C	14x12	15 x18
75	690	10	774C	16x13	16 x20
75	575	12	854C	17x14	16 x20
100	1750	4	663C	12x12	*
100	1160	6	760C	14x12	13 x16
100	870	8	774C	16x13	16 x18
100	690	10	856C	20x15	17 x20
100	575	12	874C	20x15	19 x20
125	1750	4	761C	*	*
125	1160	6	772C	*	*
125	870	8	856C	18x18	16 x20
125	690	10	874C	25x17	20 x20
125	575	12	938C	25x17	20 x20
150	1750	4	771.1C	*	*
150	1160	6	772C	18x15	*
150	870	8	870C	20x15	19 x20
150	690	10	938	21x17	22 x20
150	575	12	954	28x18	22 x22
200	1750	4	871C	*	*
200	1160	6	939	*	*
200	870	8	939A	22x20	22 x22
200	690	10	938	28x18	22 x20
200	575	12	954	25x20	22 x22

\*This rating is not recommended for belted service.

†Dimensions given are for minimum diameter and maximum face of special pulley.

TYPE CW MOTOR RATINGS

Ratings of type CW motors are, in general, similar to the type CS motor ratings. For more complete information, refer to our nearest district office.

## TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS

1/20 TO 200 HP. AND ABOVE      40, 115, 230 AND 550 VOLTS  
CONSTANT, VARYING AND ADJUSTABLE SPEEDS

In choosing a motor for any application careful consideration should be given to the motor's characteristics, that it may be best adapted for the service required.

Direct-current motors are classified according to the field windings as shunt, compound, and series.

In **shunt-wound motors** a small portion of the line current is shunted across the armature and used for exciting the field. In this manner the field excitation is kept uniform, giving a constant speed to the motor irrespective of its load. Such motors are used in the majority of direct-current motor installations; such as machine tools, centrifugal pumps, line shafting, printing presses, grinding and buffing wheels, automatic lathes, etc.

Adjustable speed motors are shunt-wound motors in which a field rheostat is used to adjust the motor speed, which, when once adjusted, is practically unaffected by the motor load. These motors are used where the speed requirements vary for different classes of work, particularly in machine shops, on lathes, boring mills, drills, milling machines, etc.

In a **series-wound motor**, the field winding being in series with the armature winding, the motor speed will vary inversely as the motor load.

Series-wound motors are inherently varying-speed motors. They start with very powerful torque and low starting current, the torque increasing considerably faster than in direct proportion to the current. They are capable of starting and accelerating heavy loads with lower current consumption than any other type of motor. On reduced loads the speed may become dangerously high, hence such motors can be employed only where the load is never entirely removed or where close supervision is maintained. A series motor should never be connected by belt to its load, but always by gear, chain, or coupling.

Series motors are used chiefly for widely varying loads where extreme speed changes are permissible, and where the operator is always on the job; as hoists, cranes, winches, etc.

**Compound-wound motors** are varying speed motors having both a shunt and a series winding for field excitation. They are intermediate in characteristics between the shunt and the series motors, resembling more closely the one which the field winding most nearly approximates. These motors are used where the required torque varies considerably, being high at starting or during some part of the cycle of operations, and where at the same time the speed limiting characteristic of shunt motors

is desirable. A compound-wound motor should be used in preference to a shunt-wound motor where either the motor or the machine is to be started or reversed at frequent intervals, also where the load fluctuates and a fly-wheel may be used to advantage. In the latter case, the motor speed drops off as the load comes on, allowing the flywheel to give up some of its stored energy.

For severe mill service such as bending rolls, etc., the motors are heavily compounded, having only



TYPE CD MOTOR

enough shunt winding to limit the light load operating speed. At heavier loads these motors have all the operating features of series motors.

**Service Conditions**—All motors are built and rated for either continuous or intermittent service. In many cases motors are rated for both continuous and intermittent service. The intermittent service rating is always given for a specified duration of time.

**Starting and Speed Adjustments**—For starting a direct-current motor, a low-voltage release starting rheostat, or starting box, is generally used. Fuses or a circuit-breaker should also be installed to protect it from injurious overloads.

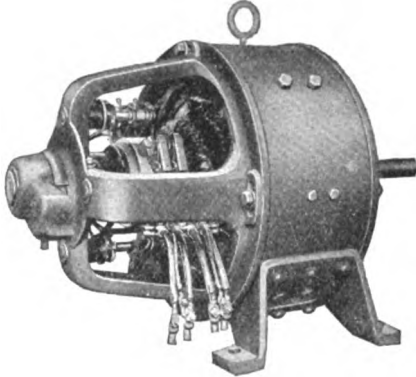
Speed adjustments are obtained in two ways:

(a) By adjustable resistance in the armature circuit. By this method all speeds obtained are below the normal rated full-load speed. This method is satisfactory for intermittent service, such as operating cranes, hoists, etc., and also for continuous service where the required torque varies with the speed, and where the torque at any given speed adjustment remains constant as in driving fans, blowers, and centrifugal pumps. It is not economical where the torque remains constant or nearly so at all speeds, because of the high resistance loss at reduced speeds. Nor is it satisfactory where the torque varies at any given speed adjustment, as in machine tool service.

## TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

## SHUNT AND COMPOUND WOUND

## TYPE CD GENERATORS

 $\frac{1}{4}$  to 2 Kw. 40, 125 and 250 Volts

TYPE SK MOTOR

(b) By adjustable resistance in the shunt field circuit. Speeds obtained by this method are always greater than the minimum rated full-load speed. This method is very economical and satisfactory for most applications, especially where adjustable speed is required with varying load at the different speed adjustments, as in machine tool service. Caution is necessary in using field control with compound-wound motors in varying torque service. At high speed adjustment such motors operate practically as series machines, and on light load, the speed may become excessively high.

Some controllers combine these two methods, so that speed adjustments may be made either above or below the normal rated speed.

The Westinghouse type CD motor is suitable for driving such small devices as washing machines, job presses, conveyors, drill presses, pumps, etc. Type CD motors are well designed for strength and compactness and will operate successfully with hard usage and unskilled handling to which they are often subjected. Type CD motors can be furnished with semi-enclosing and splash-proof covers where this protection is required.

Speed control of the low-speed ratings can be obtained by the use of a field rheostat in the shunt field circuit.

Westinghouse type SK motors are designed for general constant-speed and adjustable-speed power service, and therefore find extensive application to machines used in practically every industry. They are equally suitable for driving machine tools and for other classes of service where the load is frequently started, stopped or reversed.

Type SK generators are designed for supplying electrical energy in places where an independent

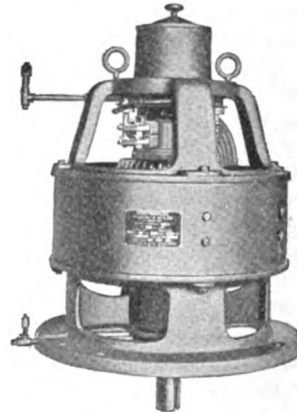
## TYPE SK GENERATORS

3 to 150 Kw. 125 and 250 Volts

source is desired. They also find a wide use as exciters, and for charging storage batteries.

Type SK generators can be furnished in both the two wire and three wire types.

The chief features of type SK motors and generators are their admirable operating characteristics. The use of commutating poles insures excellent commutation under all conditions of load and speed with fixed brush position. The efficiency is high and the overload capacity is ample for any service within the range of the machine. The bearings are dust-proof and of large area. Oil-ring lubrication is used. The lubricating system is so designed that no oil from the reservoir can be thrown either outside or inside the motor.



TYPE SK VERTICAL MOTOR. IF NECESSARY FOR SHAFT TO CLEAR FLOOR, EXTENDED LOWER BRACKET CAN BE FURNISHED

Besides the standard open type SK motors they are made with splash-proof, semi or totally enclosed frames, with back gears, with conduit terminal box, with idler pulleys and with vertical shafts. Special designs for elevator service can also be furnished.

Westinghouse type CD generators of small capacity are suitable for use as part of farm lighting outfits, for lighting country residences, and for furnishing light and power to small industrial plants in localities where central station power is not available. Their applications include battery charging and exciter service.

They are characterized by simple and rugged construction, light weight, small size and excellent commutation. These generators can be easily installed, and require little attention beyond occasional oiling of the bearings and wiping of the commutator with a piece of dry canvas.



TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

OUTLINE DIMENSIONS  
TYPE CD MOTORS AND GENERATORS

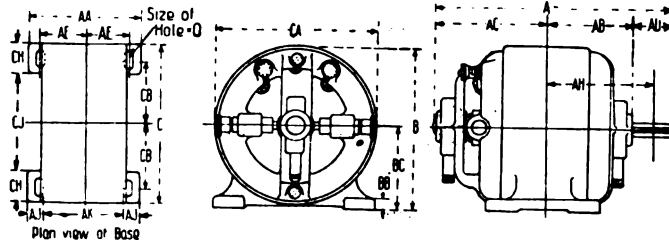


FIG. 1—TYPE CD FRAMES No. 323, 423 AND 625

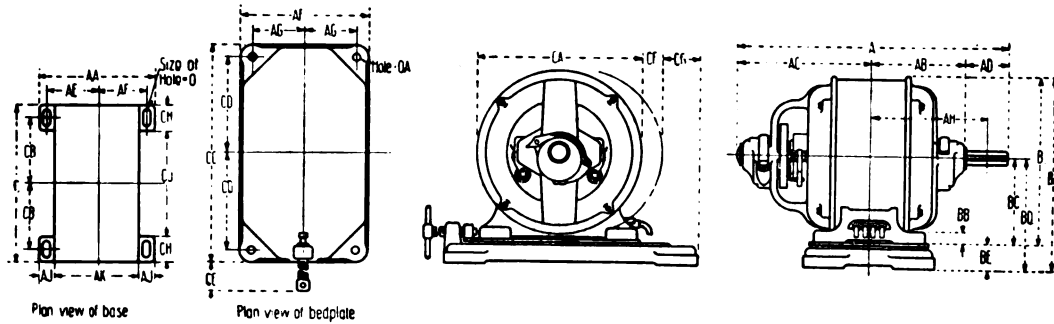


FIG. 2—TYPE CD FRAMES No. 723, 725, 823, 823-C, 825, 923 AND 925

DIMENSIONS IN INCHES

Ref. No.	Fig. No.	Frame No.	KEYWAY			Flat for Set Sc.	Shaft Dia.	A	AA	AB	AC	AD	AE	AF	AG	AH	B	BA
			Width	Depth	Length													
I	1	323	..	..	..	1/2 X 1	3/8	7 5/8	3 1/2	2 3/8	3 1/2	1	1 1/2	..	..	1 1/2	4 1/2	..
II	1	423	..	..	..	3/4 X 1 1/2	5/8	8 3/8	3 5/8	2 3/8	4 1/2	1 3/8	1 3/8	..	..	3 1/2	5 3/8	..
III	1	*625	3/16	3/8	1	3/4 X 1 1/2	5/8	11 1/2	5	4 3/8	5 3/8	1 1/2	2 1/8	5 7/8	2 1/2	4 3/8	7 7/8	8 3/8
IV	2	723	5/16	3/8	1 3/8	..	3/4	13 7/8	5 1/4	4 3/4	6 7/8	2 1/4	2 1/8	7 1/4	3	5 7/8	8 3/8	10 3/8
V	2	725	5/16	3/8	1 3/8	..	3/4	14 5/8	6	5 1/4	7 1/4	2 1/4	2 1/8	7 1/4	3	6 1/4	8 3/8	10 3/8
VI	2	823-C	5/16	3/8	2 1/8	..	3/4	17 3/8	7	6	9	2 3/4	2 3/8	7 3/4	3 1/4	7 3/8	11 3/8	12 3/8
VII	2	823	5/16	3/8	2 1/8	..	3/4	17 3/8	6 5/8	5 3/4	8 1/2	2 3/4	2 3/8	8 3/4	3 3/4	7 1/8	10 3/8	11 3/8
VIII	2	825	5/16	3/8	2 1/8	..	3/4	18 3/8	7 5/8	6 1/4	9 3/8	2 3/4	3 1/4	8 3/4	3 3/4	7 5/8	10 3/8	11 3/8
IX	2	923	5/16	3/8	3 1/2	..	1 1/4	24 3/8	8 3/4	8 1/2	12 1/4	3 7/8	3 3/8	10	4 1/4	10	12 3/8	14 1/8
X	2	925	5/16	3/8	3 1/2	..	1 1/4	25 3/8	8 3/4	8 5/8	12 5/8	3 7/8	3 3/8	10	4 1/4	10 3/8	12 3/8	14 1/8

Ref. No.	Fig. No.	Frame No.	BB	BC†	BD†	BE	C	CA	CB	CC	CD	CE	CF	CG	O		OA
															Width	Depth	
I	1	323	3/8	2 7/16	..	..	4 5/8	4 1/2	1 7/8	..	..	..	..	..	3/8	1 1/2	..
II	1	423	3/8	2 3/4	..	..	5 3/4	5 3/8	2 3/8	..	..	..	..	..	3/8	1 1/2	..
III	1	*625	1/2	3 3/8	4 1/2	7/8	7	7	2 7/8	9 3/4	4 1/2	1 3/4	1 1/4	3/4	3/8	1 1/8	3/8
IV	2	723	5/16	4 3/8	6 1/2	1 1/8	8 1/2	8 3/8	3 3/8	13 3/4	6 1/4	2 1/2	2	1 1/4	3/8	1 1/8	3/8
V	2	725	5/16	4 3/8	6 1/2	1 1/8	8 1/2	8 3/8	3 3/8	13 3/4	6 1/4	2 1/2	2	1 1/4	3/8	1 1/8	3/8
VI	2	823-C	3/4	5 3/4	7	1 1/4	11 1/4	11 1/8	4 1/2	16 1/2	7 5/8	3 1/2	2	1 3/8	1 1/2	1 1/2	3/8
VII	2	823	3/4	5 3/8	6 7/8	1 1/2	9 7/8	10 1/2	3 5/8	15	6 7/8	2 1/2	2	1 3/8	1 1/2	1 1/2	3/8
VIII	2	825	3/4	5 3/8	6 7/8	1 1/2	9 7/8	10 1/2	3 5/8	15	6 7/8	2 1/2	2	1 3/8	1 1/2	1 1/2	3/8
IX	2	923	7/8	6 1/2	8 3/8	1 5/8	12 1/4	12 3/8	4 7/8	18 1/2	8 1/2	3 3/8	2 1/2	1 3/8	1 3/8	1 3/8	3/8
X	2	925	7/8	6 1/2	8 3/8	1 5/8	12 1/4	12 3/8	4 7/8	18 1/2	8 1/2	3 3/8	2 1/2	1 3/8	1 3/8	1 3/8	3/8

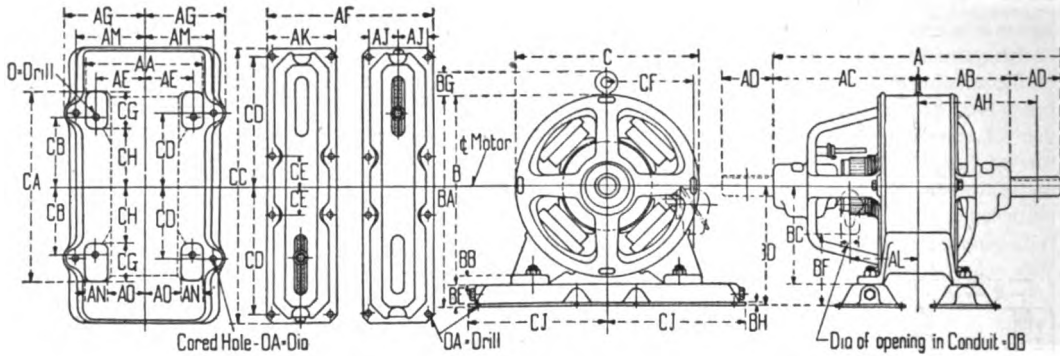
\*Frame 625 has both keyway and flat diametrically opposite each other and is used as a generator only.  
 †Diameter of cast hole.  
 ‡This dimension will never be exceeded but may vary to 1/4-inch less than shown in table.  
 §Frame 823-C has a cast iron frame and front bracket in one piece. The leads are brought out on the upper left hand side of the front bracket.  
 Above dimensions are for reference only. For official dimensions refer to our nearest district office.

TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

OUTLINE DIMENSIONS

TYPE SK TWO-BEARING MACHINES

Frames 23 to 123 Inc.



DIMENSIONS IN INCHES

Ref. No.	Frame No.	Shaft Dia.	DIMENSIONS CORRESPONDING TO LETTERS IN OUTLINE VIEWS																				
			KEYWAY			A	AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK	† AL	AM	AN	AO	B	BA	BB
			Wid.	Dep.	Lgt.																		
I	*23	1 3/8	3/8	1/8	3 3/8	27 1/2	13 3/4	9 7/8	13 3/4	4 3/8	5 1/2	17 1/2	8 3/4	11 1/2	...	6 3/8	7 3/8	2 3/8	4	15 3/8	18 3/8	3 3/8	
II	*33	1 1/2	3/8	1/8	4	29 3/4	13 3/4	10 3/8	14 1/2	4 3/8	5 3/8	17 1/2	8 3/4	12 1/2	...	6 7/8	7 7/8	2 3/8	4	16 3/8	18 3/8	3 3/8	
III	43	1 5/8	3/8	1/8	4 1/4	31 1/4	14	10 3/4	15 1/2	5 3/8	5 3/8	18 3/8	9 1/4	13 1/2	2 3/8	6 7/8	8 1/8	...	3 3/8	4 1/4	17 1/2	19 1/2	7 3/8
IV	53	1 5/8	3/8	1/8	4 1/2	33 3/8	14 1/2	11	16 1/2	5 3/8	5 3/8	18 1/2	9 1/4	14 1/2	2 3/8	6 7/8	8 1/8	...	3 3/8	4 3/8	18 3/8	20 3/8	7 3/8
V	63	1 3/4	3/8	1/8	5 3/8	34 1/2	14 1/2	11 3/8	16 3/4	6 3/8	6 3/8	19 1/2	9 1/4	14 1/2	2 3/8	6 7/8	8 1/8	...	3 3/8	4 3/8	18 3/8	20 3/8	7 3/8
VI	63-A	1 3/4	3/8	1/8	5 3/8	34 1/2	14 1/2	11 3/8	16 3/4	6 3/8	6 3/8	19 1/2	9 1/4	14 1/2	2 3/8	6 7/8	8 1/8	...	3 3/8	4 3/8	18 3/8	20 3/8	7 3/8
VII	83	1 7/8	3/8	1/8	5 3/8	36 1/2	14 3/4	11 3/8	18 1/4	6 3/8	6 3/8	20	10	15	3 1/8	7 3/8	9 3/8	...	2 3/8	4 3/8	22 3/8	25 1/2	1
VIII	93	2	1/2	1/8	6 1/8	37 3/8	14 3/4	11 3/8	18 5/8	7 3/8	6 3/8	20	10	15 1/2	3 1/8	7 3/8	10 1/8	...	2 3/8	4 3/8	22 3/8	25 1/2	1
IX	103	2 1/8	1/2	1/8	6 1/8	38 5/8	16	12	19 1/2	7 3/8	6 3/8	21 3/4	10 7/8	16 3/8	3 3/8	9 1/8	10 7/8	...	3 3/8	4 3/8	25 1/2	29	1 1/2
X	113	2 1/4	9/16	1/8	6 5/8	39 3/8	16	12 1/2	19 3/8	7 3/8	6 3/8	22 1/4	11 1/4	16 3/8	3 3/8	9 1/8	10 3/8	...	3 3/8	4 3/8	25 1/2	29	1 1/2
XI	123	2 3/8	9/16	1/8	6 7/8	42	17	13 3/8	20 3/8	8 3/8	7 3/8	23 1/4	11 3/4	17 1/8	3 3/8	9 1/8	12 1/8	...	3 3/8	4 3/8	28 3/8	31 3/8	1 1/2
XII	123-L	2 3/8	9/16	1/8	6 7/8	43 3/8	17	13 3/8	22 3/8	8 3/8	7 3/8	23 1/4	11 3/4	17 1/8	3 3/8	9 1/8	12 1/8	...	3 3/8	4 3/8	28 3/8	31 3/8	1 1/2
XIII	133	2 5/8	5/8	1/8	7 1/2	44 3/8	18	14 1/4	21 3/8	8 3/8	7 3/8	23 1/4	11 3/4	19 1/8	3 3/8	9 1/8	12 1/8	...	3 3/8	4 3/8	30 3/8	33 3/8	1 1/2

Ref. No.	Frame No.	DIMENSIONS CORRESPONDING TO LETTERS IN OUTLINE VIEWS																APPROX. NET Wt., LBS.			Style No. of Rails	Max. Travel of Motor on Rails		
		† BC	† BD	BE	BF	BG	BH	C	CA	CB	CC	CD	CE	† CF	CG	CH	CJ	O	OA	OB			Armature	Bare Motor
I	*23	8	10 3/8	2 3/8	5	2 3/8	2 1/4	15 3/4	15 3/8	6 3/8	21	6 3/8	...	7	2 3/8	5 3/8	10 1/2	2 3/8	1 3/8	61	260	275	370433	4
II	*33	8 1/4	10 3/8	2 3/8	5	2 3/8	2 1/4	15 7/8	16 1/2	6 3/8	21	6 3/8	...	7	2 3/8	5 3/8	10 1/2	2 3/8	1 3/8	77	315	340	370434	4
III	43	9 1/8	11 1/8	2	6	3 3/8	3 1/4	17 1/2	18 1/2	7 3/8	27 1/8	...	8 3/8	9 3/8	2 3/8	6 3/8	13 3/8	1 3/8	110	410	440	366774	4 1/2	
IV	53	9 1/2	11 1/2	2	5 1/4	3 3/8	3 1/4	18 3/8	19	7 3/8	27 1/8	...	8 3/8	9 3/8	3	6 1/2	13 3/8	1 3/8	126	460	495	297563	4 1/2	
V	63	9 1/2	11 1/2	2	5 1/4	3 3/8	3 1/4	18 3/8	19	7 3/8	27 1/8	...	8 3/8	9 3/8	3	6 1/2	13 3/8	1 3/8	133	515	550	297563	4 1/2	
VI	63-A	9 1/2	11 1/2	2	5 1/4	3 3/8	3 1/4	18 3/8	19	7 3/8	27 1/8	...	8 3/8	9 3/8	3	6 1/2	13 3/8	1 3/8	143	525	560	297563	4 1/2	
VII	83	11 1/2	13 7/8	2 3/8	5 5/8	3 3/8	3 1/2	22 3/8	23	9 3/8	33	...	11 1/2	12 3/4	3 3/8	8 1/2	16 1/2	2 3/8	190	700	750	297566	6	
VIII	93	11 3/4	14 1/2	2 3/8	5 7/8	3 3/8	3 1/2	22 3/8	23 1/2	9 3/8	33	...	11 1/2	12 3/4	3 3/8	8 1/2	16 1/2	2 3/8	220	800	850	297567	5 1/2	
IX	103	13 3/8	16 1/4	3 3/8	7 3/4	4	3 3/8	25 1/2	26 1/4	11 3/8	40 1/2	19 3/8	4 3/8	13 3/8	3 3/8	9 5/8	20 1/2	1 3/8	249	900	975	303237	5 1/2	
X	113	13 3/8	16 1/4	3 3/8	7 3/4	4	3 3/8	25 1/2	26 1/4	11 3/8	40 1/2	19 3/8	4 3/8	13 3/8	3 3/8	9 5/8	20 1/2	1 3/8	280	975	1050	303237	5 1/2	
XI	123	14 1/4	17 3/8	3 3/8	8 7/8	3 3/8	4	27 3/8	28 1/2	12 3/8	40 1/2	19 3/8	4 3/8	13 7/8	4	10 1/4	20 1/2	1 3/8	330	1145	1275	303238	5 1/2	
XII	123-L	14 1/4	17 3/8	3 3/8	8 7/8	3 3/8	4	27 3/8	28 1/2	12 3/8	40 1/2	19 3/8	4 3/8	14	4	10 1/4	20 1/2	1 3/8	340	1255	1310	303238	6 1/2	
XIII	133	15 3/4	18 7/8	3 3/8	10 1/4	4 3/8	4 3/8	29 1/2	30	11 3/8	40 1/2	19 3/8	4 3/8	14 1/2	5 1/2	10 1/4	20 1/2	1 3/8	409	1455	1585	303239	5	

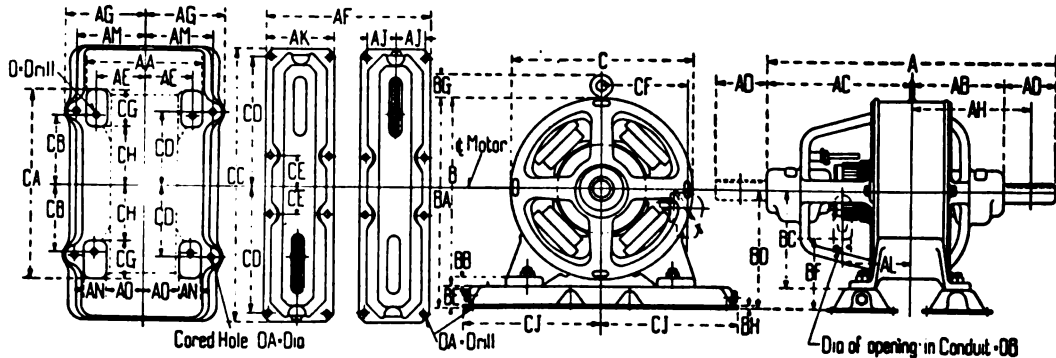
\*Frames 23 and 33 have bedplates instead of rails.  
 †This dimension will never be exceeded. When exact dimension is required, liners up to 1/8 in. may be necessary.  
 ‡This dimension will be to centerline of cleat when conduit box is not used.  
 Tolerances on shaft extensions 1 1/2 in. dia. up to 2 in. dia. +.000 and -.001, above 2 in. dia. up to 3 1/2 in. dia. +.0000 and -.0015.  
 Above dimensions are for reference only. For official dimensions refer to our nearest district office.

TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

OUTLINE DIMENSIONS

TYPE SK TWO-BEARING MACHINES

Frames 143 to 183 Inc.



DIMENSIONS IN INCHES

Ref. No.	Frame No.	Shaft Dia.	KEYWAY			DIMENSIONS CORRESPONDING TO LETTERS IN OUTLINE VIEWS																
			Wid.	Dep.	Lgt.	A	AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK	AL	AN	AO	B	BA	BB
I	143	2 7/8	1/4	1/4	8 3/4	47 7/8	20	15 1/8	23 1/8	9 1/2	8 1/8	25 1/2	12 3/4	20	3 3/4	9 3/4	13	4	14	31 1/8	34 1/8	13 1/8
II	143-L	2 7/8	1/4	1/4	8 3/4	49 5/8	20	15 1/8	25 1/8	9 1/2	8 1/8	25 1/2	12 3/4	20	3 3/4	9 3/4	13	4	14	31 1/8	34 1/8	13 1/8
III	153	2 7/8	1/4	1/4	8 3/4	48 3/8	21 3/4	15 1/8	24 3/8	9 1/2	8 1/8	29 3/4	14 1/2	21 1/8	5 1/4	12 1/2	13 1/4	4 1/2	6 3/8	34 1/8	38 3/8	1 3/8
IV	163	3 3/8	1/4	1/4	8 3/4	54 3/4	21 3/4	16 1/8	27 3/8	10 1/2	8 1/8	29 3/4	14 1/2	21 1/8	5 1/4	12 1/2	15 1/2	4 3/4	6 3/8	37 1/8	41 1/8	1 5/8
V	173	3 3/8	1/4	1/4	10 3/4	57 3/4	24	16 1/8	28 3/8	12	9 1/8	31 3/4	15 1/8	22 1/2	5 1/4	12 1/2	15 1/2	5 1/4	6 3/8	37 1/8	41 1/8	1 3/4
VI	183	3 3/8	1/4	1/4	12	61 3/8	25 1/4	18 1/8	29 3/8	13 1/2	9 1/8	...	24 1/4	...	...	15 1/2	5 1/4	6 3/8	40 3/8	...	...	1 3/4
VII	153-L	2 7/8	1/4	1/4	8 3/4	52 1/8	21 3/4	15 1/8	27 3/8	9 1/2	8 1/8	29 3/4	14 1/2	21 1/8	5 1/4	12 1/2	13 1/4	4 3/4	6 3/8	34 1/8	38 3/8	1 1/8
VIII	163-L	3 3/8	1/4	1/4	8 3/4	58	21 3/4	16 1/8	30 3/8	10 1/4	8 1/8	29 3/4	14 1/2	21 1/8	5 1/4	12 1/2	15 1/2	4 3/4	6 3/8	37 1/8	41 1/8	1 3/8
IX	173-L	3 3/8	1/4	1/4	10 3/4	61 1/8	24	16 1/8	32 3/8	12	9 1/8	31 3/4	15 1/8	22 1/2	5 1/4	12 1/2	15 1/2	5 1/4	6 3/8	37 1/8	41 1/8	1 3/4
X	183-L	3 3/8	1/4	1/4	12	65 3/8	25 1/4	18 1/8	33 3/8	13 1/2	9 1/8	...	24 1/4	...	...	15 1/2	5 1/4	6 3/8	40 3/8	...	...	1 3/4

Ref. No.	Frame No.	DIMENSIONS CORRESPONDING TO LETTERS IN OUTLINE VIEWS																APPROX. NET WGT., LBS.		Style No. of Rails	Max. Travel of Motor on Rails				
		BC	BD	BE	BF	BG	BH	C	CA	CB	CC	CD	CE	CF	CG	CH	CJ	O	OA			OB	Armature	Bare Motor	
I	143	16 1/4	19 3/8	3 1/8	...	4 3/8	3/8	30 5/8	31 3/4	11 5/8	40 1/2	19 3/8	4 3/8	12 1/2	6	9 1/2	20 1/4	1 3/8	1 3/8	...	532	1750	1885	303240	6 1/4
II	143-L	16 1/4	19 3/8	3 1/8	...	4 3/8	3/8	30 5/8	31 3/4	11 5/8	40 1/2	19 3/8	4 3/8	12 1/2	6	9 1/2	20 1/4	1 3/8	1 3/8	...	560	2005	2135	303240	6 1/4
III	153	17 1/2	21 3/4	4	...	4 3/8	1/2	33 1/4	34	13	49 1/2	23 3/8	5 1/4	13 1/4	6 3/4	10 1/2	24 3/4	1 3/8	1 3/8	...	650	2110	2310	303505	6 1/4
IV	163	19 1/2	23 3/8	4	...	5 3/8	1/2	36	36 1/4	14 1/2	49 1/2	23 3/8	5 1/4	14 1/2	6 3/4	11 3/8	24 3/4	1 3/8	1 3/8	...	840	2560	2780	303506	8 1/4
V	173	19 3/8	23 3/8	4	...	5 3/8	1/2	36 3/8	38	14 3/8	49 1/2	23 3/8	5 1/4	15	7 5/8	11 3/8	24 3/4	1 3/8	1 3/8	...	950	2970	3190	303504	8
VI	183	20 1/2	...	...	...	5 3/8	...	39 3/8	40	15 3/8	...	...	...	16 1/2	8 1/2	11 1/2	...	1 3/8	1 3/8	...	1070	3375	...	303503	6
VII	153-L	17 1/2	21 3/4	4	...	4 3/8	1/2	33 1/4	34	13	49 1/2	23 3/8	5 1/4	13 1/4	6 3/4	10 1/2	24 3/4	1 3/8	1 3/8	...	690	2400	2500	303505	6
VIII	163-L	19 1/2	23 3/8	4	...	5 3/8	1/2	36	36 1/4	14 1/2	49 1/2	23 3/8	5 1/4	14 1/2	6 3/4	11 3/8	24 3/4	1 3/8	1 3/8	...	900	2560	2780	303506	8 1/4
IX	173-L	19 3/8	23 3/8	4	...	5 3/8	1/2	36 3/8	38	14 3/8	49 1/2	23 3/8	5 1/4	15	7 5/8	11 3/8	24 3/4	1 3/8	1 3/8	...	1010	2810	2930	303504	8
X	183-L	20 1/2	...	...	...	5 3/8	...	39 3/8	40	15 3/8	...	...	...	15 1/2	8 1/2	11 1/2	...	1 3/8	1 3/8	...	1130	3540	...	303503	6

† This dimension will never be exceeded. When exact dimension is required, liners up to 1/4 inch may be necessary.  
 ‡ This dimension will be to centerline of cleat when conduit box is not used.  
 Tolerances on shaft extensions—1 1/4 in. dia. up to 2 in. dia. +.000 and -.001; above 2 in. dia. up to 3 1/4 in. dia. +.0000 and -.0015.  
 Above dimensions are for reference only. For official dimensions refer to our nearest district office.

TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

RATINGS

TYPE CD AND SK GENERATORS

Type CD Generators

Kw.	AMPERES		Approx. Rpm. at Full Load	Frame No.	Std. Pulley Dia. x Face	APPROX. NET WT., LBS.	
	125 Volts	250 Volts				Generator Only	Add for Sliding Base
<b>125 and 250 Volts Compound-Wound Generators for General Service</b>							
1/4	2	1	1725	625	3 x 1 1/4	30	5
1/2	4	2	2150	723	3 1/2 x 2 1/2	45	12
3/4	6	3	2150	725	3 1/2 x 2 1/2	54	12
1	8	4	2150	823	3 1/2 x 3	84	23
1 1/4	12	6	2150	825	3 1/2 x 3	100	23
1 1/2	12	6	1450	925	4 x 3	195	30
2	16	8	2000	923	4 x 3	170	30
2	16	8	1750	925	4 x 3	195	30

40 Volt Shunt-Wound Generators for Charging 32-Volt Batteries

.50	..	..	1800	723	3 1/2 x 2 1/2	45	12
.65	..	..	1725	725	3 1/2 x 2 1/2	54	12
.80	..	..	1800	823	3 1/2 x 3	84	23
1.00	..	..	1700	823-C	3 1/2 x 3	110	15

Type SK Generators

Kw.	AMPERES		Full Load Rpm.	Frame No.	Standard Pulley Diam. x Face Inches
	125 Volts	250 Volts			
<b>125 and 250 Volts</b>					
3	24	12	1750	23	4x 4
5	40	20	1750	33	5x 4 1/2
5	40	20	1450	43	7x 6
7 1/2	60	30	1750	43	7x 6
7 1/2	60	30	1450	53	7x 6
10	80	40	1750	63	6x10
10	80	40	1450	63	6x10
10	80	40	1150	83	9x 8
15	120	60	1450	83	9x 8
15	120	60	1150	93	9x 8
20	160	80	1750	83	9x 8
20	160	80	1450	93	9x 8
25	200	100	1750	93	9x 8
25	200	100	1450	103	10x 9
30	240	120	1750	103	10x 9
30	240	120	1450	113	12x10
40	320	160	1750	123	13x12
40	320	160	1450	123	13x12
40	320	160	1150	143	15x12
50	400	200	1750	143	15x12
50	400	200	1150	153	14x12
50	400	200	750	163	18x15
75	600	300	1150	163	18x15
75	600	300	750	183	21x17
100	800	400	1150	173	18x15

TYPES CD AND SK DIRECT-CURRENT MOTORS AND GENERATORS—Continued

RATINGS

TYPE SK MOTORS

Constant Speed

Hp.	Full Load Rpm.	Frame No.	Standard Pulley Diam. x Face In.	Hp.	Full Load Rpm.	Frame No.	Standard Pulley Diam. x Face In.
<b>115 Volts</b>				<b>230 Volts—Continued</b>			
3	1150	23	4x 4	30	575	143	13x12
5	1750	23	4x 4	40	1700	103	10x 9
5	1150	33	5x 4	40	1150	123	11x10
5	850	43	6x 5	40	850	133	12x12
7½	1150	43	6x 5	40	575	153	14x12
7½	850	63	7x 6	50	1700	113	*
10	1150	63	7x 6	50	1150	133	12x12
10	850	83	8x 7	50	850	143	13x12
15	1150	83	8x 7	50	575	163	16x13
15	850	93	9x 8	75	1700	133	*
20	1150	93	9x 8	75	1150	153	14x12
25	1150	103	10x 9	75	850	163	15x13
25	850	113	11x10	75	575	183	21x17
25	575	133	12x12	100	1700	143-L	*
30	1150	113	11x10	100	1150	163	16x13
40	1150	123-L	11x10	100	850	173	18x15
40	850	133	12x12	125	1150	173	18x15
50	850	143-L	13x12	150	1100	183ET	*
50	575	163	16x13				
<b>230 Volts</b>				<b>550 Volts</b>			
3	1150	23	4x 4	3	1200	23	4x 4
5	1750	23	4x 4	5	1750	23	4x 4
5	1150	33	5x 4	5	1200	33	5x 4
5	850	43	6x 5	7½	1750	33	5x 4
7½	1750	43	6x 5	7½	1150	43	6x 5
7½	1150	43	6x 5	10	1750	43	6x 5
7½	850	63	7x 6	10	1150	63	7x 6
10	1750	63	7x 6	15	1750	63	7x 6
10	1150	63	7x 6	15	1150	83	8x 7
15	1750	63	7x 6	20	1150	93	9x 8
15	1150	83	8x 7	25	1150	103	10x 9
15	850	93	9x 8	25	575	133	12x12
20	1750	83	8x 7	30	1150	113	11x10
20	1150	93	9x 8	40	1700	103	10x 9
20	850	103	10x 9	40	1150	123	11x10
20	575	123	11x10	40	850	133	12x12
25	1150	103	10x 9	40	575	153	14x12
25	850	113	11x10	50	1700	113	*
25	575	133	12x12	50	850	143	13x12
30	1750	93	9x 8	50	575	163	16x13
30	1150	113	11x10	75	850	163	16x13
30	850	123	11x10	100	850	173	18x15
				125	1150	173	18x15
				150	1100	183ET	*

Adjustable Speed—230 Volts

Hp.	Frame No.	SPEED		Hp.	Frame No.	SPEED	
		Minimum	Maximum			Minimum	Maximum
2	23	700	2100	15	103	400	1600
2	33	500	2000	15	123	300	1200
3	33	650	1950	20	113	500	1500
3	43	500	2000	20	123	400	1600
5	43	650	1950	20	143	300	1200
5	53	450	1800	25	123	500	1500
7½	53	600	1800	25	133	400	1600
7½	63-A	450	1800	25	153	300	1200
10	63-A	600	1800	35	143	500	1500
10	83	400	1600	35	163	300	1200
10	103	300	1200	50	163	400	1200
15	93	550	1650	50	173	300	1200

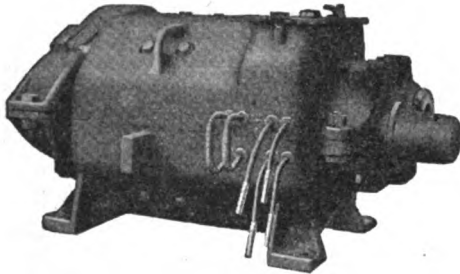
## MILL AND CRANE MOTORS

TYPES MCA, MCB—4 TO 250 hp. 230 AND 550 VOLTS

TYPES MCOA, MCOB—35 TO 300 hp. 230 AND 550 VOLTS

TYPE MA—5 TO 162 hp.

TYPE K—2 TO 65 hp.



TYPE MCB ENCLOSED MILL MOTOR

### Mill Motors

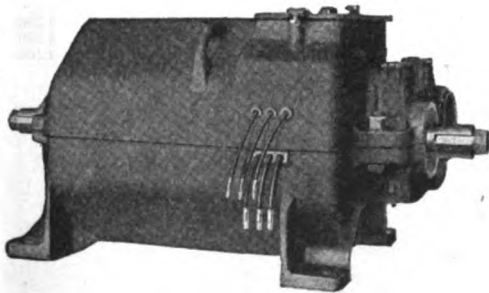
**Types MCA, MCB, MCOA and MCOB**—These motors are applicable to intermittent service such as operating steel mill auxiliaries, cranes, contractors' hoists, mine hoists, railway turn-tables, transfer tables, railway lift bridges, draw-bridges, electric shovels, etc.

These motors are of a special and very rugged construction, designed to operate under the most severe service and to withstand the mechanical shocks to which mill motors are subjected; this service is in most cases intermittent. The ideal application for this type of motor is for a cycle of operation in which the motor for a considerable portion of time is accelerating, retarding and standing at rest, and the motor seldom operates for any considerable time at a fixed continuous load.

The applications in steel mills where these types are most desirable are roll tables, side guards, screw-downs, tilting fingers, transfers, lift table mechanism, etc., where the periods of operation are short and high momentary torques are required.

### Type MA

Westinghouse type MA alternating-current high-torque, wound-rotor, steel mill motors have

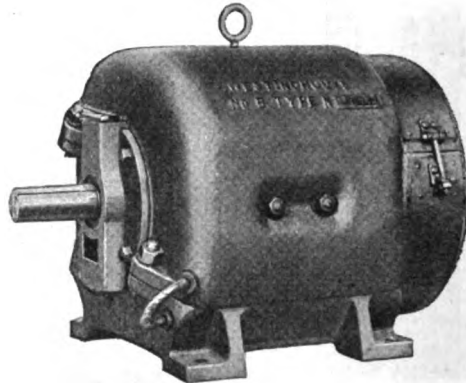


TYPE MA MILL MOTOR

been especially designed to withstand the severe service conditions in iron and steel mills, brick plants, cement mills, electric shovels etc. The general features of construction are based on the results obtained through long and successful experience with the manufacture of direct-current steel mill motors, so that thoroughly satisfactory operation is assured.

### Crane Motors

**Type K**—Westinghouse direct-current crane motors are designed for severe, intermittent, varying speed service where high starting torque is required, as for driving cranes, hoists, coke-charging machines, and applications for which rugged series-wound motors are best adapted. Many hundred thousand



TYPE K CRANE MOTOR

horsepower of these motors are in service and their constantly growing use testifies to their excellence. Their special features are compactness, reliability, simplicity, and ease of inspection and repair. The speed and torque characteristics are those which have been found to be best suited to the service requirements.

Accessibility is obtained by having a split frame easily opened up. Small over-all dimensions permit it to be installed in cramped spaces and mountings can be made on floor, wall, or ceiling. Uniform heat distribution prevents hot spots.

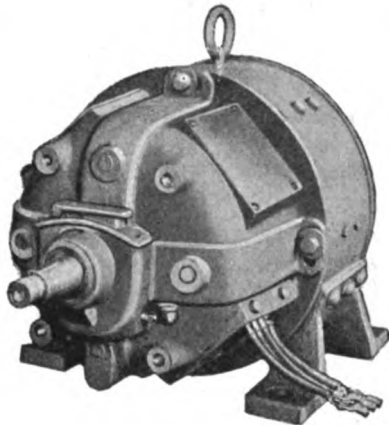
Where desired electrically operated brakes can be supplied. These brakes are self-contained and have no exposed moving parts.

Complete description of the motors will be furnished on request.

## MILL AND CRANE MOTORS—Continued

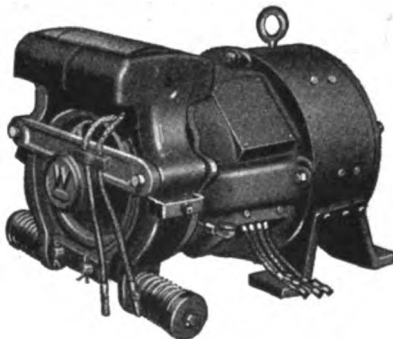
**Type HK D-C. Series and Compound Wound—2 to 25 hp.****Type CI A-C. Wound Rotor—1½ to 200 hp.**

Westinghouse type HK direct-current series and compound wound motors are designed for severe, intermittent, varying speed service, such as crane, hoist and similar service, where high starting torque is required, and where the load consists of a series of starts, stops and reversals, the motor being idle only for short periods of time.



TYPE HK Motor

The motors are of the enclosed construction with small openings in the lower part of the brackets for ventilation. Efficient cooling is thereby obtained which gives the type HK motor a high continuous rating for an intermittent duty motor. Removable covers on the upper part of the front bracket give access to the brushes and the commutator. The most prominent feature of this motor is its compact construction, giving small over-all dimensions, light weight, and great mechanical strength. The low over-all height of this motor makes it particularly adaptable for use on cranes, where only low overhead room is available. Motors of 5 hp. and above can be provided with back gears; cast-iron gears and forged-steel pinions are standard, and rawhide pinions can be supplied if desired.

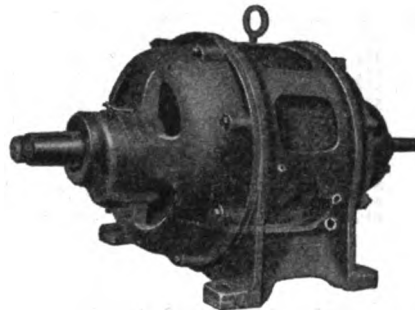


TYPE HK MOTOR WITH TYPE HB BRAKE

As shown in preceding illustration, an electrically operated brake (Type HB) can be mounted on the type HK motor. These brakes are of the shoe type and give smooth positive braking action.

Westinghouse type CI wound-rotor motors are especially designed for heavy duty on cranes, hoists, lift and swing bridges, railway turntables, transfer tables, etc., and are adapted, both mechanically and electrically, to meet the requirements of severe intermittent varying-speed reversing service. Long experience in motor building and thorough familiarity with the service requirements, have resulted in a motor that is giving satisfactory service under all industrial conditions for which it was designed.

The frames and brackets are very strong and massive. The frames of the smaller sizes are made of steel laminations riveted between forged steel end-shields, twelve rivets being used; frames of the larger sizes are cast iron. Maximum strength has been attained, while weight and over-all dimensions have been reduced to a minimum. The self-oiling bearings of the oil-ring type are ample in size to insure



TYPE CI MOTOR

long wear and are very cool running. Cast iron brackets with reinforced ribs, accurately machined to fit the frame, assure the utmost rigidity and perfect alignment of the bearings at all times.

The rotor is small in diameter, thus reducing the flywheel effect. This feature, together with perfect balance and secure attachment of the windings, makes these motors especially adapted for frequent starting, stopping, and reversing. The shaft is of axle steel; it can be removed from the rotor without disturbing the windings. Standard motors are furnished with tapered shaft extension at both ends.

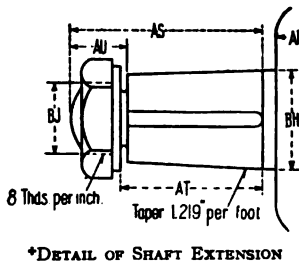
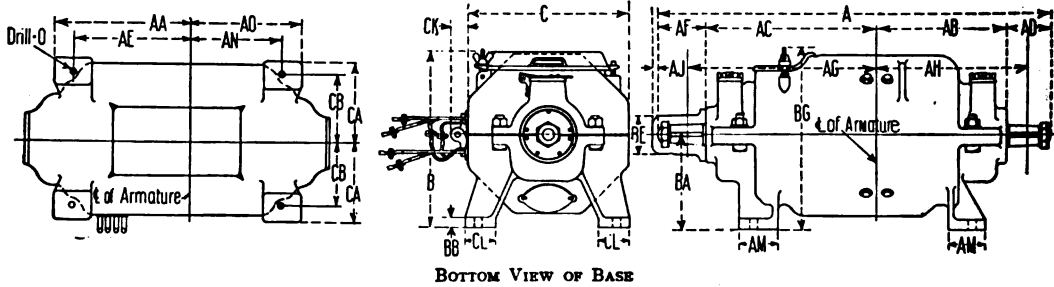
Partially-closed slots and shaped coils are used in both the rotor and stator of the smaller motors. Larger motors have open slots and form-wound coils held in place by wedges. All coils are well insulated, and those of the stator are rigidly braced at the ends by means of insulated steel rings.

Type CI motors possess excellent electrical characteristics and the pull-out torque of all motors is approximately two and one half times full-load torque.

MILL AND CRANE MOTORS—Continued

OUTLINE DIMENSIONS

Type MCA D-C. Mill Motors—Without Countershaft Bracket



\*DETAIL OF SHAFT EXTENSION

Frame No.	SHAFT KEY WAY INCHES			DIMENSIONS IN INCHES CORRESPONDING TO LETTERS IN OUTLINE VIEWS					
	Width	Depth	Length	A	AA	AB	AC	AD	AE
20	1/2	3/8	3 3/8	43 1/8	12 1/4	14 1/4	19 1/8	4 3/8	10 3/8
30	5/8	1/2	3 3/8	46 3/4	16 1/4	15 1/4	20 1/8	5 3/8	14 1/8
40	3/4	3/4	4 3/8	51	18 3/8	16 3/8	22 3/8	5 3/8	16 3/8
50	3/4	3/4	4 3/8	52 1/2	17 1/4	17 1/4	23 1/8	5 3/8	15 1/8
60	3/4	3/4	4 1/2	60 3/4	22 1/4	19 3/8	27 3/8	6 3/8	20
70	3/4	1/2	4 1/2	62 3/4	23 3/8	20 1/2	28 1/2	6 3/8	21 3/8
80	1	1/2	4 1/2	69 1/2	24 3/8	22 3/8	32 3/8	7	22 3/8
90	1	1/2	5 1/2	73 1/2	23 3/8	24 3/8	32 3/8	8	20 3/8
100	1 1/4	1/2	5 1/2	79 3/4	*31 1/2	26 3/8	36 3/8	8 3/8	*28 3/8
103	1 1/4	1/2	5 1/2	79 3/4	*31 1/2	26 3/8	36 3/8	8 3/8	*28 3/8

Frame No.	DIMENSIONS IN INCHES CORRESPONDING TO LETTERS IN OUTLINE VIEWS													
	AF	AG	AH	AJ	AM	AN	AO	AR	AS	AT	AU	B†	BA	BB
20	4 7/8	21 1/8	16 1/4	1 3/8	4 3/4	11	12 1/4	1/4	4 3/8	3 1/2	1 1/4	18 1/2	10	1
30	5 3/8	22 3/8	17 1/4	1 3/8	4 1/2	11 1/4	13 1/4	1/4	5 1/8	4	1 1/4	20 1/2	11	1 1/4
40	5 3/8	25 1/8	19 1/4	1 3/8	**5	13 3/4	15 3/8	1/4	5 5/8	4 1/2	1 1/4	23 3/8	12 1/2	1 1/4
50	5 3/8	26 3/8	19 1/4	1 3/8	5	14 1/4	16 1/4	1/4	5 5/8	4 1/2	1 1/4	25 1/2	13	1 1/4
60	6 3/8	30 3/8	22 1/2	1 3/8	5 1/2	14 1/2	16 1/4	1/4	6 3/8	5	1 1/4	28 1/2	15	1 1/2
70	6 3/8	31 1/4	23 1/4	1 3/8	5 3/4	15 3/8	17 3/8	1/4	6 3/8	5	1 3/4	28 3/4	15	1 1/2
80	7	35 1/8	25 3/8	1 3/8	7	18 1/2	20 1/4	1/4	6 3/4	5	1 1/2	31 1/8	16	1 3/4
90	8	35 5/8	28 1/8	1 3/8	**8 3/4	19 1/2	22 1/4	1/4	7 3/8	6	1 3/8	33 3/8	16 3/4	1 3/4
100	8 1/4	40	30	1 3/8	10	*15 1/2	*21 1/2	1/4	7 3/8	6	2	36 3/8	18 1/2	1 3/4
103	8 1/4	40	30	1 3/8	10	*15 1/2	*21 1/2	1/4	7 3/8	6	2	36 3/8	18 1/2	1 3/4

Frame No.	DIMENSIONS IN INCHES CORRESPONDING TO LETTERS IN OUTLINE VIEWS										ARMATURE BEARINGS INCHES		APPROX. NET WT., LBS.	
	BE	BG*	BH	BJ	C	CA	CB	CK	CL	O	Diam.	Length	Motor	Armature
20	4 1/8	19 1/8	2	1 1/4	17 1/8	9	7 3/4	2	3 1/4	1 1/2	3 1/2	5 3/4	690	136
30	4 3/8	20 3/8	2 1/2	1 3/4	19	9 3/4	8 1/4	2	3 3/4	1 1/2	2 1/2	6	1060	222
40	5	25 1/8	3	2	21 3/4	12 1/4	10 1/2	2 1/2	5	1 1/2	4 1/2	6 1/2	1580	368
50	5	27 1/4	3	2	24 1/4	12 3/8	10 3/2	2 3/4	5	1 1/2	3	6 1/2	2080	476
60	5 3/4	30 3/8	3 3/4	2 1/2	26 3/8	13 1/4	11	...	5	1 1/2	3 3/4	8	2830	785
70	5 3/4	30 3/4	3 3/4	2 1/2	27 1/4	15	12 1/2	...	5 3/4	1 1/2	3 3/4	8	3380	965
80	6 3/8	33 3/4	4 3/8	3 1/2	30 1/4	15 1/4	13	...	6 1/4	1 1/2	4 3/4	9	4550	1375
90	7 3/8	34 1/2	4 3/8	3 1/2	37 1/4	18	15 1/4	...	5 3/4	1 1/2	4 3/4	10	5650	1500
100	8 1/2	38	5 1/4	4	41	21	18 1/4	...	7 1/2	1 1/2	5 1/4	11	7600	2187
103	8 1/2	38	††5 1/4	4	41	21	18 1/4	...	7 1/2	1 1/2	††5 1/4	11	7650	2250

\*To highest part of motor frame.  
 †This dimension will never be exceeded. When exact dimension is required liners up to 1/4 inch may be necessary.  
 ‡Face of gear.  
 \*\*For commutator end; for pinion end dimension (AM) on the 40 frame is 4 inches and on the 90 frame is 7 1/2 inches.  
 ††For commutator end; for pinion end the dimension is 5 1/4 inches.  
 ‡‡For commutator end; for pinion end the dimension is 3/8 inch.  
 ‡‡‡For commutator end; for pinion end the dimensions are 1 1/2 x 1/2 inch.



MILL AND CRANE MOTORS—Continued

RATINGS

Enclosed Motors—Types MCA and MCB

Hours	FRAME No. 20 WR <sup>2</sup> =8				FRAME No. 30 WR <sup>2</sup> =16				FRAME No. 40 WR <sup>2</sup> =37				FRAME No. 50 WR <sup>2</sup> =49						
	HP.	230 VOLTS		RPM.	HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS	
		Series	Comp.			Series	Comp.	Series	Comp.		Series	Comp.	Series	Comp.		Series	Comp.		
5	4	925	885	7	925	840	1150	1175	14	710	750	840	875	20	680	630	815	830	
2	5	800	800	10	765	760	1000	1025	18	610	680	760	800	25	590	590	735	760	
1	6	700	725	12	700	710	915	950	20	600	650	735	775	30	525	550	665	710	
1/2	7.5	600	625	15	600	645	825	865	27	490	555	635	700	37	465	500	600	650	
1/4	8.5	525	550	18	540	600	775	610	33	435	500	550	650	45	420	450	550	600	

Hours	FRAME No. 60 WR <sup>2</sup> =18				FRAME No. 70 WR <sup>2</sup> =170				FRAME No. 80 WR <sup>2</sup> =285						
	HP.	230 VOLTS		RPM.	HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS		
		Series	Comp.			Series	Comp.	Series	Comp.		Series	Comp.			
5	28	585	600	750	725	40	575	560	650	675	50	615	560	675	650
2	35	510	565	665	675	50	525	530	600	625	70	515	515	580	590
1	40	475	540	625	650	60	475	500	550	600	80	480	520	550	575
1/2	65	410	460	500	550	87	400	440	490	540	110	410	450	475	530
1/4	80	385	420	460	500	105	380	405	460	515	130	380	430	450	510

Hours	FRAME No. 90 WR <sup>2</sup> =335				FRAME No. 100 WR <sup>2</sup> =640				FRAME No. 103 WR <sup>2</sup> =645						
	HP.	230 VOLTS		RPM.	HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS		
		Series	Comp.			Series	Comp.	Series	Comp.		Series	Comp.			
5	62	650	525	750	650	83	490	430	525	565	100	600	575	700	675
2	80	560	500	660	610	118	415	390	465	480	145	525	525	600	625
1	100	500	475	600	580	150	370	365	435	435	180	485	500	565	600
1/2	140	415	430	515	535	200	330	335	390	410	250	435	475	515	570
1/4	180	370	395	480	500	250	300	315	360	400	300	400	455	485	550

Open Motor, Types MCOA and MCOB

Hours	FRAME No. 60 WR <sup>2</sup> =118				FRAME No. 70 WR <sup>2</sup> =170				FRAME No. 80 WR <sup>2</sup> =285						
	HP.	230 Volts		RPM.	HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS		
		Series	Comp.			Series	Comp.	Series	Comp.		Series	Comp.			
5	35	565	560	675	675	47	525	525	610	630	65	520	525	615	600
2	45	490	525	600	625	57	480	490	565	605	75	480	500	575	585
1	50	465	510	565	600	70	440	465	530	570	90	450	480	525	560
1/2	65	425	460	500	550	90	400	425	485	535	110	410	450	475	530
1/4	80	390	420	460	500	105	370	395	460	515	130	380	430	450	510

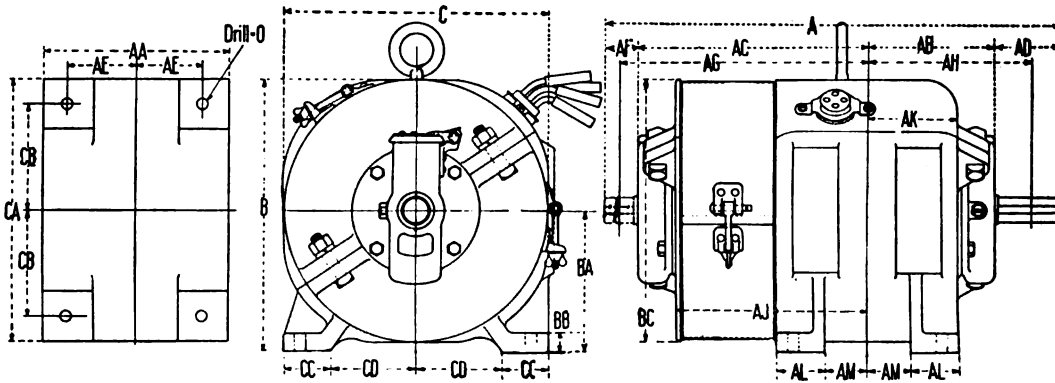
Hours	FRAME No. 90 WR <sup>2</sup> =335				FRAME No. 100 WR <sup>2</sup> =725				FRAME No. 103 WR <sup>2</sup> =860						
	HP.	230 VOLTS		RPM.	HP.	230 VOLTS		550 VOLTS		HP.	230 VOLTS		550 VOLTS		
		Series	Comp.			Series	Comp.	Series	Comp.		Series	Comp.			
5	80	560	495	650	610	120	400	385	480	465	150	500	525	600	625
2	95	510	475	600	590	140	380	370	450	445	170	480	515	575	610
1	115	460	455	550	575	165	350	350	420	425	200	450	500	550	509
1/2	150	410	425	500	525	210	325	330	385	410	250	410	475	515	570
1/4	185	365	390	475	495	280	300	310	360	395	300	385	455	485	550

MILL AND CRANE MOTORS—Continued

OUTLINE DIMENSIONS

TYPE K DIRECT-CURRENT MOTORS

With and Without Standard-Shaft Extension on Commutator End\*



DIMENSIONS IN INCHES

Frame No.	Shaft Diam.	KEYWAY†			DIMENSIONS IN INCHES						
		Width	Depth	Length	A	AA	AB	AC	AD	AE	AF
*1	1 1/4	3/8	1/8	2 3/4	22 3/8	8	5 3/8	10	2 1/2	3 1/4	4 1/4
*2	1 3/8	3/8	1/8	2 3/4	24 1/8	9	6 1/8	10 3/8	2 1/2	3 3/4	4 1/4
3	1 7/8	3/8	1/8	4	26 3/8	10 1/2	7	11 3/8	4 1/8	4 1/4	4 1/4
4	1 7/8	3/8	1/8	4	27 3/8	11 1/2	7 1/8	12 1/8	4 1/8	4 3/4	4 1/4
5	1 7/8	1/2	3/8	4	30 3/8	13	8 3/8	13 3/8	4 3/8	5 3/8	4 1/4
6	2 1/4	1/2	3/8	5	33 1/8	15	10 1/8	14 3/8	5 1/8	6 1/4	4 1/4
7	2 3/8	5/8	1/2	6	34 3/8	15	9 3/8	14 3/8	6 1/4	6 1/4	4 1/4
8	2 3/8	5/8	1/2	6	36 3/8	16 1/2	10 3/8	15 1/8	6 1/4	6 1/4	4 1/4
9	2 3/8	5/8	1/2	6	49 3/8	17 1/2	15 3/8	20 3/8	6 1/4	7 1/4	6 1/4
10	3 1/4	3/4	1/2	6	50	18 3/4	15 3/4	22 3/4	6 1/4	7 1/2	6 1/4

Frame No.	AG	AH	†B	BA	BB	C	CA	CB	O	APPROX. NET WT., LBS.	
										Complete Motor	Armature
*1	12 1/8	7 1/8	12	6 1/4	3/8	11 1/8	11 1/8	5	3/8	190	42
*2	13	7 3/8	14	7 1/4	1	13 3/8	13 3/8	5 7/8	5/8	275	63
3	13 3/8	9 1/8	15 1/2	8	1	15	15 1/8	6 1/8	5/8	400	90
4	14 3/8	9 1/2	16	8 3/4	3/4	15 1/8	15 3/8	6 3/8	5/8	450	126
5	15 3/8	10 1/8	17 3/4	9 3/8	3/4	17 1/4	17 3/8	7 1/8	5/8	680	200
6	16 3/8	12 3/8	18 1/4	9 3/8	3/8	18	18 3/8	8 3/8	3/4	900	247
7	16 3/8	13 3/8	19 3/8	10	1/2	19 1/4	20	8 3/8	1 1/8	1000	310
8	17 3/8	13 3/8	20 3/8	10 1/4	1	19 3/4	20	8 3/8	1 1/8	1200	360
9	24	18 1/8	23	11 1/4	1 1/4	22 1/4	22 3/8	9 3/8	1 1/8	1800	440
10	25 3/8	18 3/8	25 1/4	12 3/8	1 1/2	24 1/4	24 3/8	10 3/8	1 1/2	2200	600

\*All frames are regularly furnished with shaft extension on commutator end, except Nos. 1 and 2, which are furnished with shaft extension only when specially ordered.

†This dimension will never be exceeded. When exact dimension is required liners up to 1/16 inch may be necessary on frames 3 and smaller, and up to 1/8 inch on frames 4 and larger.

‡Dimensions apply to both pinion end and commutator end extensions.

Above dimensions are for reference only. For official dimensions refer to our nearest district office.

MILL AND CRANE MOTORS—Continued

RATINGS

TYPE K DIRECT-CURRENT SERIES-WOUND MOTORS

Frame No.	Hp. ½-Hr. 55° C.	Approximate Rpm.	Hp. ½-Hr. 55° C.	Approximate Rpm.	Hp. 1-Hr. 55° C.	Approximate Rpm.	Hp. 2-Hr. 55° C.†	Approximate Rpm.†	Hp. 5-Hr.** 55° C.†	Approximate Rpm.†	Max. Running Torque Lbs. at 1 Ft. Rad.	Max. Starting Torque Lbs. at 1 Ft. Rad.
<b>115 VOLTS</b>												
1	3	675	2.5	910	1.9	1125	1.4	1375	1	1725	20	37
2	5.25	800	4.5	900	3.4	1150	2.9	1250	2	1600	35	62
3	7.75	600	6.5	690	5.25	800	3.5	1050	2.75	1250	62	109
4	12.5	800	10	890	7.25	1080	5	1150	3.75	1550	84	141
5	19	550	15	630	11.25	760	8	925	6	1100	138	232
6	25	430	20	495	14	630	10	725	7.5	875	225	376
7	32	470	26	525	19	640	12.5	825	9	1000	287	470
8	40	475	32	535	23	630	17	750	12.5	900	380	643
9	53	475	42	525	29	650	20	800	15	975	500	825
10	62	435	50	475	35	560	25	650	18	800	620	1030
<b>230 VOLTS</b>												
1	2.7	675	2.25	835	17.5	1125	1.25	1550	1	1850	20	37
1	4.25	1075	3.5	1275	2.5	1725	1.5	2250	1	2500	20	37
2	5	600	4.25	715	3.25	925	2.75	1100	2	1400	35	62
2	7	900	6	1050	4.75	1275	3.75	1525	2.5	2000	35	62
3	7.5	585	6.25	680	5	835	3.5	1080	2.75	1300	62	109
3	10	950	8.5	1085	6	1375	4.25	1640	3	1850	62	109
4	12.5	600	10	690	7.25	850	5	1100	3.75	1326	84	141
4	15	690	12.5	1000	9	1175	6	1400	4	1600	84	141
5	19	550	15	630	11.25	740	8	900	6	1100	138	232
5	25	875	20	975	14.5	1125	10	1400	7	1750	138	232
6	25	460	20	515	14.5	610	10.5	735	8	875	225	376
6	35	910	27.5	1050	19	1266	12	1625	9	1800	225	376
7	35	485	27.5	535	20	630	13	800	10	940	287	470
7	40	885	31.5	985	21.5	1160	14	1450	10	1700	287	470
8	42	450	33	505	23.5	600	17.5	740	13	900	380	643
8	55	800	42.5	910	30	1100	20	1400	14	1800	380	643
9	57	470	45	515	31	630	22	750	16	925	500	825
9	65	700	50	775	35	915	22	1160	16	1400	500	825
10	75	425	60	470	42.5	550	30	630	22	735	620	1030
10	85	635	65	700	45	815	30	950	21	1100	620	1030
<b>550 VOLTS</b>												
1	3	700	2.5	965	1.9	1250	1.3	1700	1	1950	20	37
2	5	700	4.25	855	3.25	1100	2.75	1300	2	1675	35	62
3	8.25	680	7	795	5.5	965	3.75	1300	3	1525	62	109
4	12.5	660	10	790	7.25	965	5	1260	3.75	1525	84	141
5	19	575	15	660	11.25	785	8	1100	6	1200	138	232
6	27.5	550	22	625	16	750	11.5	950	8.5	1150	225	276
7	37	560	29	630	21	730	13.5	1000	10	1250	287	470
8	45	590	36	665	25	780	18.5	975	13.5	1225	380	643
9	60	495	48	555	32.5	660	23	785	17	940	500	825
10	70	475	56	525	40	600	28	725	20	900	620	1030

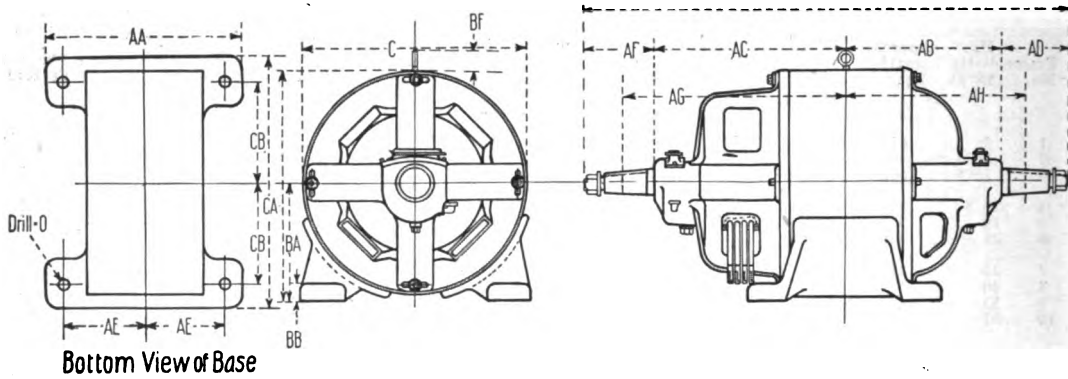
Frame No.	115-230-550 VOLTS		
	APPROX. NET WEIGHT, LBS.		
	Armature	Bare Motor	Motor With KT Brake
1	42	190	245
2	63	275	330
3	90	400	508
4	126	450	574
5	200	680	804
6	247	900	1078
7	310	1000	1178
8	360	1200	1428
9	440	1800	2040
10	600	2200	2440
			Motor Back-Geared
			215
			300
			455
			510
			755
			1000
			1100
			1335
			1965
			2390

†The 2 and 5-hour ratings are only approximate.  
 \*\*R. M. S. Rating.

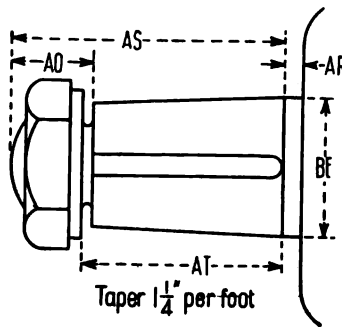
MILL AND CRANE MOTORS—Continued

OUTLINE DIMENSIONS

TYPE HK DIRECT-CURRENT MOTORS



Ref No.	Frame No.	DIMENSIONS IN INCHES																	APPROX. WT.			
		A	AA	AB	AC	AD	AE	AF	AG	AH	AJ	B	BA	BB	BF	C	CA	CB	CE	O	Arm.	Complete Motor
I	0	23 1/8	7 3/8	6 1/4	9 7/8	3 3/8	3 1/4	3 3/8	11 1/4	9 1/4	1 5/8	10 1/4	5 3/8	3/4	—	10 1/4	9 7/8	3 3/8	3/4	—	20	110
II	1	29 1/8	8 3/8	8 1/4	12 1/4	4 3/8	3 3/8	2 3/4	14 3/8	11 1/4	1 7/8	12 1/4	6 3/8	3/4	—	12 3/4	12 1/4	4 1/2	3/4	—	40	204
III	2	27 3/8	13	8 1/2	12	3 3/8	5 1/8	3 1/2	13 3/8	10	—	14 3/8	7 3/8	3/4	2 3/8	13 3/4	15 3/8	6 3/4	3/4	—	68	252
IV	3	29 3/8	13	9 1/4	12 3/4	3 3/8	5 1/2	3 1/2	14 3/8	10 3/4	—	14 3/8	7 3/8	3/4	2 3/8	13 3/4	15 3/8	6 3/4	—	75	298	
V	4	30 3/8	13 1/4	9 3/4	13 1/2	4 3/8	5 3/8	3 3/4	14 3/8	11 1/4	—	16	8 1/4	1	2 5/8	15 1/2	16 1/2	6 3/8	—	3/4	90	385
VI	5	36 3/8	14 1/2	10 3/4	16 1/4	5 3/8	6 3/8	3 3/4	17 1/4	13 3/8	—	18 1/4	9 1/4	1 1/8	3 3/8	17 3/4	18 3/4	7 3/8	—	1	147	575
VII	6	37 3/8	14 3/4	11 3/8	16 3/8	6	6 3/8	3 3/4	18 1/4	13 3/8	—	18 1/4	9 1/4	1 1/8	3 3/8	17 3/4	18 3/4	7 3/8	—	1	167	631
VIII	7	39 3/8	16 3/8	12 3/4	17 3/8	6	7 3/8	3 3/4	19 1/4	14 3/8	—	18 1/4	9 1/4	1 1/8	3 3/8	17 3/4	18 3/4	7 3/8	—	1	191	723



TAPER IS 1/4" PER FOOT ON DIAMETER  
DETAILS OF SHAFT EXTENSION

Ref. No.	Frame No.	DIMENSIONS IN INCHES														
		SHAFT EXTENSION														
		COMMUTATOR END					PINION END									
		AO	AR	AS	AT	BE	KEYWAY			OA	AR	AS	AT	BE	KEYWAY	
Width	Depth						Length	Width	Depth						Length	
I	0	9/16	1 1/4	2 3/8	1 1/4	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 1/2	1	1/4	1/8	1 3/8
II	1	5/8	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
III	2	5/8	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
IV	3	5/8	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
V	4	3/4	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
VI	5	1	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
VII	6	1	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8
VIII	7	1	1 3/4	2 3/4	1 3/8	7/8	3/8	3/8	1 3/8	3/4	1 3/8	1 3/4	1 1/4	1/4	1/8	1 3/8

Above dimensions are for reference only. For official dimensions refer to our nearest district office.

MILL AND CRANE MOTORS—Continued

RATINGS

TYPE HK DIRECT-CURRENT SERIES-WOUND MOTORS

Ref. No.	Hp. 1/2-Hr. Vent. 50°C.	Approx. Rpm. †	Hp. 1/2-Hr. Vent. 50°C.	Approx. Rpm. †	Hp. Enclosed 55°C.	Approx. Rpm.	Hp. 1-Hr. Vent. 50°C.	Approx. Rpm.	Hp. 2-Hr. Vent. 50°C.	Approx. Rpm.	Hp. 5-Hr. Vent. 50°C.	Approx. Rpm.	Frame No.	Max. Safe Rpm.
<b>230 Volts</b>														
I	2	900	1 1/2	1070	1 1/2	1070	1 1/4	1300	1	1500	1	1500	0	4000
II	3	900	2 1/4	1040	2 1/4	1040	2	1150	2	1150	2	1150	1	3500
III	5	850	4	1000	3 3/4	1075	3 1/2	1100	3 1/2	1175	3	1250	2	3000
IV	7 1/2	800	6	950	5 1/2	1000	5	1075	4 1/2	1175	4 1/4	1225	3	3000
V	10	800	8	900	7 1/2	925	6 1/2	1000	5 1/4	1100	4 3/4	1150	4	2750
VI	15	700	13	775	12	825	10	900	8	1050	7	1125	5	2500
VII	20	650	16	750	15	800	13	875	11	1000	9	1100	6	2500
VIII	25	600	20	675	17 1/2	700	15	760	12	850	9	1000	7	2500
<b>550 Volts</b>														
IX	5	1000	4	1150	3 3/4	1200	3 1/2	1275	3 1/4	1325	3	1400	2	3000
X	7 1/2	950	6	1100	5 1/2	1160	5	1200	4 1/2	1275	4 1/4	1300	3	3000
XI	10	900	8	1025	7 1/2	1065	6 1/2	1150	5 1/4	1275	4 3/4	1350	4	2750
XII	15	800	13	875	12	900	10	1000	8	1150	7	1275	5	2500
XIII	20	750	16	850	15	875	13	975	11	1100	9	1250	6	2500
XIV	25	700	20	775	17 1/2	850	15	900	12	975	9	1125	7	2500

Ref. No.	Frame No.	BEARING SIZES IN INCHES				AXLE Dia. X Lgth.	Max. Starting Torque Lbs. at 1 Ft. Radius	Max. Running Torque Lbs. at 1 Ft. Radius	APPROX. NET Armature	WR LBS. Motor with HB Brake	Size of Brushes in Inches Width Lgth.	Arm. WR <sup>2</sup>	Std. Gear Ratio
		Front Dia. X Lgth.	Rear Dia. X Lgth.										
<b>230 Volts</b>													
I	0	7/8 x 1 1/4	1 x 2 1/4	—	—	24	18	20	110	155	1/4 x 1 x 1 1/4	.33	*
II	1	1 1/4 x 3 1/8	1 1/4 x 3 1/2	—	—	57	40	40	204	249	3/8 x 1 x 1 1/4	1.00	*
III	2	1 1/2 x 3	1 3/4 x 3 1/2	2	x4	95	75	68	252	362	3/8 x 1 x 1 1/4	2.25	5.4
IV	3	1 1/2 x 3	1 3/4 x 3 1/2	2	x4	150	110	75	298	408	3/8 x 1 x 1 1/4	2.48	5.4
V	4	1 3/4 x 3 1/2	2 x 4	2 1/2	x5	240	170	90	385	495	3/8 x 1 x 1 1/4	3.65	4.95
VI	5	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	400	300	147	575	765	3/8 x 1 x 1 1/4	8.25	5.23
VII	6	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	530	400	167	631	821	3/8 x 1 x 1 1/4	9.5	5.23
VIII	7	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	720	550	191	723	913	3/8 x 1 x 1 1/4	10.7	5.23
<b>550 Volts</b>													
IX	2	1 1/2 x 3	1 3/4 x 3 1/2	2	x4	95	60	68	252	362	1/4 x 1 x 1 1/2	2.25	5.4
X	3	1 1/2 x 3	1 3/4 x 3 1/2	2	x4	150	90	75	298	408	1/4 x 1 x 1 1/2	2.48	5.4
XI	4	1 3/4 x 3 1/2	2 x 4	2 1/2	x5	240	140	90	385	495	1/4 x 1 x 1 1/2	3.65	4.95
XII	5	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	400	240	147	575	765	3/8 x 1 x 1 1/4	8.25	5.23
XIII	6	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	530	340	167	631	821	3/8 x 1 x 1 1/4	9.5	5.23
XIV	7	2 x 4	2 1/2 x 5	2 3/4	x5 1/2	720	450	191	723	913	3/8 x 1 x 1 1/4	10.7	5.23

†Speeds of compound-wound motors are approximately 10 per cent higher than for series wound.

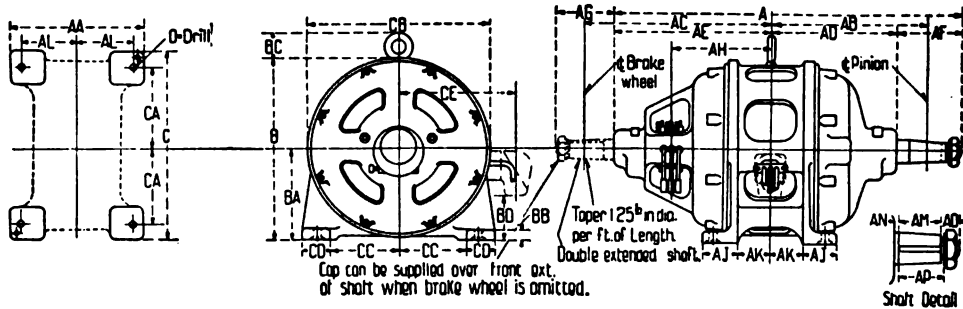
\*Not furnished backgeared.

MILL AND CRANE MOTORS—Continued

OUTLINE DIMENSIONS

TYPE CI ALTERNATING-CURRENT WOUND-ROTOR MOTORS

Frame Classes 200 to 900 (Geared Service)



DIMENSIONS IN INCHES

Ref. No.	*Frame No.	PULLEY END—SHAFT EXTENSION								OPPOSITE END—SHAFT EXTENSION								A	AA	AB
		Shaf. Dia.	KEYWAY			SHAFT DETAIL				Shaf. Dia.	KEYWAY			SHAFT DETAIL						
			Wid.	Dep.	Lth.	AM	AN	AO	AP		Wid.	Dep.	Lth.	AN	AO	AP	AR			
I	230C to 239C	1 1/4	3/4	3/8	1 1/4	1 1/4	1/2	1 3/8	2	1 1/4	3/4	3/8	1 1/4	2 1/4	1 1/2	1	1 1/4	25 3/4	12 3/4	9 3/4
II	370C to 379C	1 3/8	3/4	3/8	2 3/4	2 3/4	1/2	1 1/4	2 1/2	1 1/4	3/4	3/8	3 3/8	4 1/4	1 3/8	1 1/2	3 1/4	33 1/4	16	13 1/4
III	460C to 469C	1 3/4	1 1/4	1/2	2 1/2	2 1/2	3/4	1 1/2	3	1 3/4	3/4	3/8	1 3/4	2 1/2	1 1/2	1 1/4	1 1/2	35	16 1/2	15 3/4
IV	480D to 489D	2 3/8	1 1/2	1/2	4 3/4	4 3/4	3/4	1 1/2	4 1/2	1 3/8	3/4	3/8	1 3/8	2 1/2	1 1/2	1 1/4	1 1/2	40 3/8	18 3/4	18 3/4
V	560C to 569C	2 3/4	1 1/2	1/2	4 3/4	4 3/4	3/4	1 1/2	4 1/2	1 1/2	3/4	3/8	2 1/4	3 1/4	1 1/2	2 3/8	39 3/8	17 3/4	18 3/4	
VI	580C to 589C	2 3/4	1 1/2	1/2	4 3/4	4 3/4	3/4	1 1/2	4 1/2	1 1/2	3/4	3/8	2 1/4	3 1/4	1 1/2	2 3/8	41 1/8	19 3/4	19 3/4	
VII	580D to 589D	2 5/8	1 1/2	1/2	4 3/4	4 3/4	3/4	1 1/2	4 1/2	1 1/2	3/4	3/8	2 1/4	3 1/4	1 1/2	2 3/8	41 3/4	19 3/4	19 3/4	

Ref. No.	*Frame No.	AC	AD	AE	AF	AG	AK	AJ	AL	B	BA	BB	BC	BD	C	CA	CB	CC	CD	CE	O
I	230C to 239C	15 3/8	8 3/4	13 3/8	3 3/8	3 3/4	4 3/8	2	5 3/8	12 1/4	6 1/4	3/4	1 3/8	3 3/8	13 3/8	5 1/4	11 3/4	4	2 3/4	7 3/4	1 1/4
II	370C to 379C	20 3/8	11 3/4	17 1/4	4 3/8	4 1/4	6	2	7	14 1/2	7 3/8	3/4	1 3/8	4 3/8	16	6 3/4	14 1/4	4 3/8	3 3/8	8 3/4	1 1/4
III	460C to 469C	18 1/4	13 3/8	16 3/4	4 3/8	4 3/4	6	2 1/4	7 1/4	17 3/8	9	3/4	1 3/8	5	19 1/4	7 1/4	17 1/4	6	3 3/4	10 3/4	1 1/4
IV	480D to 489D	19 1/4	15 3/4	17 3/4	6 3/8	4 3/4	7	2 3/4	8 1/4	17 3/8	9	3/4	1 3/8	5	19 1/4	7 1/4	17 1/4	6	3 3/4	10 3/4	1 1/4
V	560C to 569C	19 3/4	15 3/8	18	6 3/8	4 3/4	6 3/8	2 3/4	7 1/4	21 1/4	10 3/4	3/4	1 3/8	6 3/8	23 1/4	9 1/4	20 3/4	7 3/8	4	12 1/4	1 1/4
VI	580C to 589C	20 3/8	16 3/4	19	6 3/8	4 3/4	7 3/8	2 3/4	8 1/4	21 1/4	10 3/4	3/4	1 3/8	6 3/8	23 1/4	9 1/4	20 3/4	7 3/8	4	12 1/4	1 1/4
VII	580D to 589D	20 3/8	16 3/4	19	6 3/8	4 3/4	7 3/8	2 3/4	8 1/4	21 1/4	10 3/4	3/4	1 3/8	6 3/8	23 1/4	9 1/4	20 3/4	7 3/8	4	12 1/4	1 1/4

Ref. No.	*Frame No.	PULLEY END—SHAFT EXTENSION								OPPOSITE END—SHAFT EXTENSION								A	AA	AB
		Shaf. Dia.	KEYWAY			SHAFT DETAIL				Shaf. Dia.	KEYWAY			SHAFT DETAIL						
			Wid.	Dep.	Lth.	AM	AN	AO	AP		Wid.	Dep.	Lth.	AM	AN	AO	AP			
I	640C to 649C	2 7/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	4 1/2	45 5/8	18 1/2	20 3/8
II	640D to 649D	3 3/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	4 1/2	47 3/8	18 1/2	22 3/8
III	650D to 659D	3 3/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	4 1/2	49 3/8	20 1/2	23 3/8
IV	750C to 759C	3 3/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	6 1/2	52 3/8	21 1/4	22 3/8
V	750D to 759D	3 3/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	6 1/2	54 3/8	21 1/4	23 1/8
VI	770C to 779C	3 3/8	3/4	1/4	4 3/8	5 3/4	3/4	1 3/8	4 1/2	2 3/8	1 1/2	1/4	4 3/8	5 3/4	1 3/8	1 1/2	6 1/2	56 3/8	25 1/2	24 3/8
VII	850C to 859C	3 3/8	3/4	1/4	6 3/8	8 3/4	3/4	1 3/8	7	...	...	...	...	...	...	...	...	57 3/8	22 3/4	24 3/8
VIII	938-D	4 1/8	1 1/4	3/8	7 3/8	9 1/2	1	1 3/8	...	...	...	...	...	...	...	...	...	65 3/8	27 1/2	28 3/8
IX	950A to 959A	4 3/8	1 1/4	3/8	9	7	...	...	...	...	...	...	...	...	...	...	...	79 3/4	32 1/2	27 1/2

Ref. No.	*Frame No.	AC	AD	AE	AF	AG	AH	AJ	AK	AL	B	BA	BB	BC	BD	C	CA	CB	CC	CD	CE	O
I	640C to 649C	22 3/8	17 3/8	21 1/2	6 1/2	6 3/8	...	4 3/4	4 3/4	7 3/4	25 1/2	13	1 3/8	4 1/4	4 1/2	26 1/2	11	25	9 1/2	3 3/4	16 3/8	1 3/4
II	640D to 649D	22 3/8	17 3/8	21 1/2	6 1/2	6 3/8	...	4 3/4	4 3/4	7 3/4	25 1/2	13	1 3/8	4 1/4	4 1/2	26 1/2	11	25	9 1/2	3 3/4	16 3/8	1 3/4
III	650D to 659D	23 3/8	20 3/8	22 1/2	6 1/2	6 3/8	...	4 3/4	5 1/4	8 3/4	25 1/2	13	1 3/8	4 1/4	4 1/2	26 1/2	11	25	9 1/2	3 3/4	16 3/8	1 3/4
IV	750C to 759C	31 3/8	19 3/8	27 1/4	6 1/2	8 3/4	...	5 3/8	5 3/8	8 3/8	29 3/8	15 1/4	1 3/8	5 3/8	6 3/8	31	12 3/4	29 3/8	11	4 1/2	19	1 3/8
V	750D to 759D	31 3/8	20 1/4	27 1/4	6 3/8	8 3/4	...	5 3/8	5 3/8	8 3/8	29 3/8	15 1/4	1 3/8	5 3/8	6 3/8	31	12 3/4	29 3/8	11	4 1/2	19	1 3/8
VI	770C to 779C	33 3/8	21 1/8	29 1/4	6 1/2	8 3/4	...	5 3/8	7 3/8	10 3/8	29 3/8	15 1/4	1 3/8	5 3/8	6 3/8	31	12 3/4	29 3/8	11	4 1/2	19	1 3/8
VII	850C to 859C	...	19 3/8	28 3/8	8 3/8	...	...	6 1/2	4 3/4	9 3/8	34 3/8	17 3/4	2 3/8	4 3/8	8 3/8	36 1/2	15 3/8	34 1/4	13 1/4	5	21 3/8	1 3/4
VIII	938-D	...	23 3/4	31 1/4	10 1/2	...	...	6 1/2	7 1/2	11 1/2	47 1/2	24 3/4	4	...	...	42	18 3/4	45 1/2	12	9	...	1 3/4
IX	950A to 959A	37 3/8	22 1/2	32 3/4	19 3/8	9 3/8	...	6 1/4	...	14	47 1/2	24 3/4	4	...	...	14	42	18 3/4	45 1/2	9	24	1 3/4

Above dimensions are for reference only. For official dimensions refer to our nearest district office.  
 \*The illustration shows actual construction of frames 600 to 800 only. Other frames listed are similar in construction.

MILL AND CRANE MOTORS—Continued

RATINGS

TYPE CI ALTERNATING-CURRENT WOUND-ROTOR MOTORS

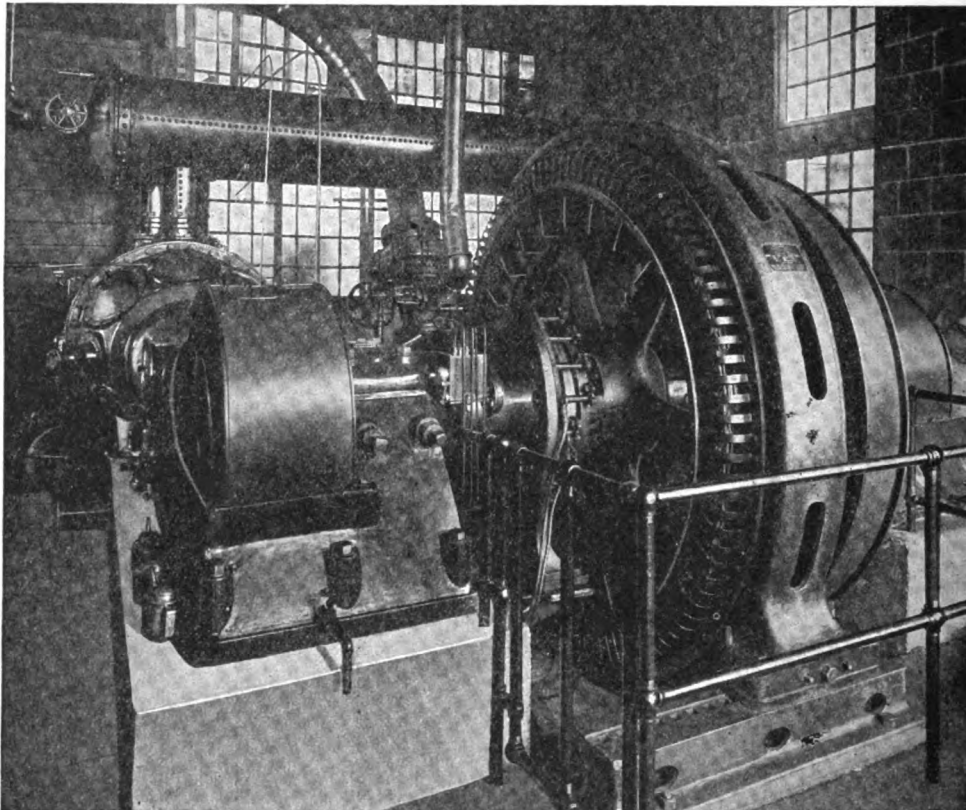
Hp. 1/4-Hr. 50°C.	Approx. Full Load Speed Rpm.	Poles	Frame No.	APPROX. POUNDS TORQUE AT ONE-FOOT RADIUS		APPROX. AMPERES 1/4-Hr. RATING		Approx. Net Wt., Lbs.
				Full Load Running	Maximum Running	220-440 Volts	550 Volts	
<b>60 Cycle, 2 and 3-Phase, 2 to 200 Hp. Inc., 220-440-550 Volts*</b>								
2	870	8	254C	12	30	8	3.5	215
3	1160	6	234C	14	35	11	5	184
3	870	8	254C	18	45	14	6.5	215
5	1160	6	254C	23	57	17	7	215
5	870	8	352C	32	80	18.5	7.5	268
7 1/2	1160	6	352C	35	87	23.5	10	268
7 1/2	870	8	370C	48	120	29.5	12.5	317
11	870	8	460C	60	150	37	15	460
11	1160	6	370C	51	127	35	14	317
15	1160	6	460C	70	175	45.5	18.5	460
15	870	8	464C	95	236	52	20.5	476
15	690	10	566C	116	290	54	22	668
20	1160	6	464C	92	230	56.5	23	476
20	870	8	480D	125	310	64.5	26	580
20	690	10	566C	155	385	71	32.5	740
25	1160	6	480D	115	285	71.5	28.5	580
25	870	8	566C	156	388	83	33	668
25	690	10	586C	190	472	7.75	31.5	790
25	575	12	644C	228	570	90	35	1400
30	1160	6	587C	135	336	85	38	694
30	870	8	582C	187	468	93.5	37	740
30	690	10	642C	228	570	90	36	1350
35	1160	6	582C	158	395	85	35	740
35	870	8	586D	218	545	95.5	38	790
35	690	10	646C	267	665	104	41	1381
35	575	12	752C	317	790	129	52	1840
50	870	8	642C	309	770	142	56.5	1570
50	690	10	654D	381	950	163	66	1570
50	575	12	774C	453	1130	185	76	2505
75	870	8	646D	460	1150	198	79	1381
75	690	10	658D	570	1420	207	82	1612
75	575	12	774C	680	1700	238	95	2505
100	690	10	754D	760	1900	291	116	2144
100	575	12	856C	905	2250	306	121	3010
150	690	10	856C	1140	2850	408	163	3010
150	575	12	874C	1360	3400	405	162	3670
<b>60 Cycle, 3-Phase, 2200 Volts</b>								
50	690	10	750C	380	950	13	.....	2014
75	870	8	752C	460	1150	19.5	.....	2044
75	690	10	774C	570	1420	20.5	.....	2505
75	575	12	774C	680	1700	22	.....	2505
100	690	10	774C	760	1900	27.5	.....	2505
100	575	12	856C	905	2260	27	.....	3010
150	690	10	876C	1140	2860	41	.....	3670
150	575	12	874C	1360	3400	43	.....	3670
200	575	12	938D	1825	4570	54	.....	4100
200	495	14	956A	2120	5320	58	.....	4900
<b>25 Cycle, 3-Phase, 220-440-550 Volts*</b>								
3	725	4	340C	23	57	9.5	3.5	200
5	725	4	352C	38	95	15	6	268
7 1/2	725	4	461C	56	140	21.5	8.5	465
10	725	4	473C	72	180	28	11	522
15	725	4	565C	115	288	43.5	17.5	741
20	725	4	583C	152	380	53	21.5	820
20	470	6	587C	227	570	55	22	905
25	725	4	587C	187	465	68	27	905
25	470	6	642C	282	705	68	27.5	1350
35	725	4	653C	257	642	92	36.5	1520
35	470	6	646C	392	980	100	40	1381
50	725	4	663C	367	920	129	52	1750
50	470	6	662C	365	910	136	54	1557
75	725	4	761C	555	1380	180	.....	2450
75	470	6	772C	840	2100	190	.....	2360
100	725	4	771.1C	774	1930	228	.....	2410
100	470	6	871C	1120	2800	240	.....	3600

\*All voltages listed are for either 2 or 3-phase, except 550 volts, which is for 3-phase only.  
 †Amperes per terminal for 220 volts; for 440 volts the ampere values are one-half of those stated.

## SYNCHRONOUS MOTORS

TYPE G—75 TO 2000 H.P.      2 AND 3-PHASE      60 CYCLES  
220, 440, 550, 1100 AND 2200 VOLTS

TYPE E—100 TO 1500 H.P.      2 AND 3-PHASE      25 AND 60 CYCLES  
220, 440, 550 AND 2200 VOLTS



TYPE E SYNCHRONOUS MOTOR DRIVING AIR COMPRESSOR

Westinghouse synchronous motors cover a wide range of speeds and ratings and are being applied in an increasing number of industries.

Synchronous motors are a strictly constant speed type of machine at all loads up to the "pull out" point, or maximum load possible to carry. As their name implies, they operate in synchronism with the line frequency, so that there is no speed change as long as the impressed frequency remains constant.

The rotating part of a synchronous motor is similar in all respects to that of a waterwheel type generator, except that it is equipped with a damper winding, embedded in the face of the pole pieces. This damper winding serves to make the machine self-starting, and during the starting period, the performance of the machine is similar to that of an induction motor.

### Type G

Westinghouse type G synchronous motors form a desirable means of driving pumps, fans, compressors and similar machinery, because in addition to driving the mechanical loads these motors can be used to raise the power factor of the circuits on which they operate. Raising the power factor increases the capacity of transformers and transmission lines, gives better voltage regulation and therefore causes lower rates for central station energy.

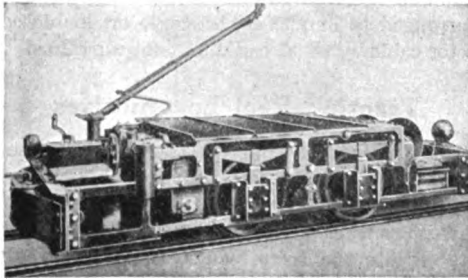
These motors start as induction motors, auto-starters being used for this purpose. After reaching full speed the motor runs on its synchronous windings, field excitation being furnished by a small direct-current generator either belted to the motor shaft or mounted on it.

M-142A



## WESTINGHOUSE-BALDWIN TROLLEY AND STORAGE BATTERY MINE LOCOMOTIVES

Westinghouse-Baldwin locomotives and locomotive equipments are manufactured in sizes and capacities suitable for any application involved in



STANDARDIZED DESIGN GATHERING LOCOMOTIVE YR-2—REEL

mining service. They are classified as follows, and can be furnished in either standard or low height:

1. Trolley locomotives are used for main haulage and gathering when equipped with gathering or cable reel.

2. Storage battery locomotives are used for both gathering and main haulage and can be used very advantageously in drifts with poor roof, in extensions and on the surface; in fact, most any place where the installation of an overhead trolley is undesirable.

3. Combination locomotives can be operated from either the trolley or the battery, which feature makes it possible to operate them any place where track is laid. The many advantages of this

combination type make them very desirable for haulage and gathering.

**Construction**—The side frames of these locomotives are of cast steel open construction. They are known as "Barsteel" frames and have the following distinct advantages:

1. Maximum strength for given weight.
2. Increased ventilation of the electrical equipment.
3. Accessibility for inspection, lubrication and adjustment.
4. Ease with which locomotive can be re-railed in case of derailment.

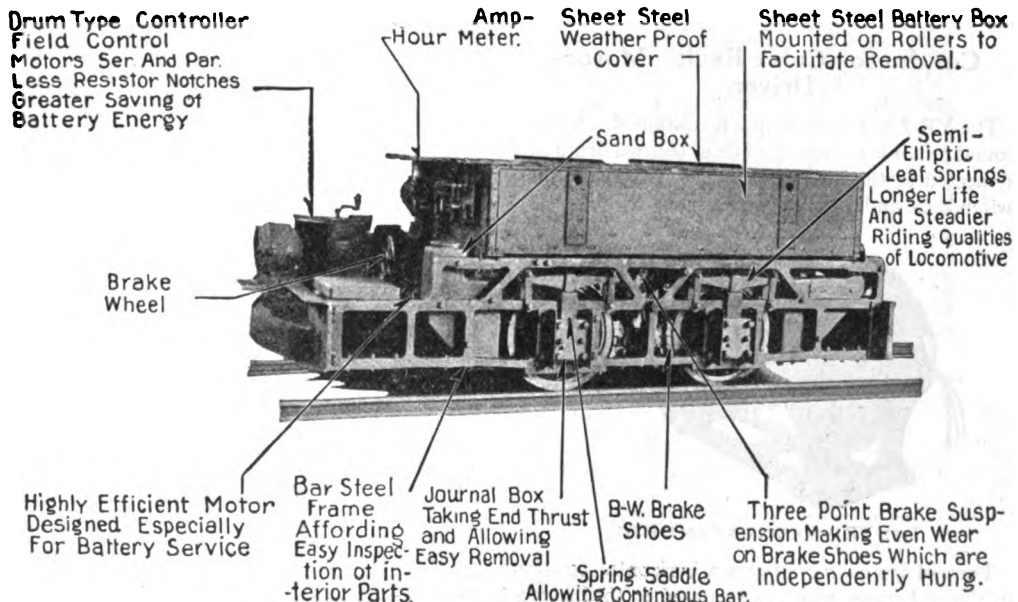
Wheels may be of cast iron with chilled treads, rolled steel, or cast iron centers with steel tires.

**Journal Boxes**—The journal boxes are of cast iron with collar cast integral, the lid being constructed to take the end thrust. Gibs of special design are used, permitting the removal and overhauling of the journal box, longitudinally, without removing the pedestal cap or dropping the axle.

**Driving Springs**—The springs are of the semi-elliptical (or leaf) type. The use of this type of spring results in a much easier riding locomotive than in the case of locomotives equipped with the ordinary helical springs.

**Brakes**—The brakes are of the automatic self-locking type operated by a screw and capable of locking all the wheels.

They are very easy to manipulate and will meet the most exacting safety requirements.



OUTSIDE FRAME BARSTEEL STORAGE BATTERY MINE LOCOMOTIVE

M-144A

## WESTINGHOUSE-BALDWIN TROLLEY AND STORAGE BATTERY MINE LOCOMOTIVES—Continued

**Motors**—The commutating pole motors used practically eliminate sparking, and brush wear is very slight.

**Controllers**—Controllers are of the magnetic blowout drum type. Full magnetic controllers are recommended for larger main haulage locomotives and are giving excellent results. A complete line is available.

**Trolley Locomotives**—The following table lists the standard sizes:

Net Weight Tons	WHEELS CHILLED IRON		WHEELS STEEL TIED	
	Rated D.B.P. in Lbs. Level Track	Max. Tractive Effort in Lbs.	Rated D.B.P. in Lbs. Level Track	Max. Tractive Effort in Lbs.
* 4	1600	2000	2000	2400
* 6	2400	3000	3000	3600
8	3200	4000	4000	4800
10	4000	5000	5000	6000
13	5200	6500	6500	7800
15	6000	7500	7500	9000
20	8000	10000	10000	12000
25	10000	12500	12500	15000

\*Standardized designs of gathering locomotives are available for these sizes.

### Gathering Locomotives

There are two types of reels supplied on Westinghouse-Baldwin gathering locomotives.

1. Conductor-cable reels, by means of which the locomotive can be operated over tracks along which the trolley wire has not been extended, being limited only by length of cable carried on the drum. In this way the empty as well as the loaded cars can be handled by the locomotive. Conductor-cable reels can be subdivided into two classes.

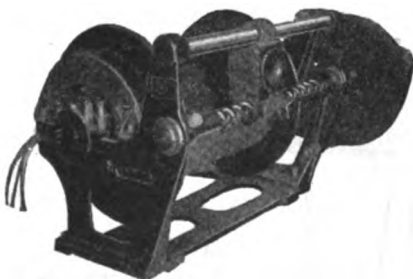
(A) Mechanically driven from locomotive running gear.

(B) Motor driven reels.

2. Traction rope reels by which cars may be pulled from any point towards the locomotive, within the limits of the length of steel rope carried on the drum. The locomotive cannot travel beyond the limits of the trolley wire nor can empty cars be pushed to the working places.

### Conductor-Cable Reels—Motor-Driven

The YR-2 reel is entirely self-contained. A shunt wound motor is mounted inside of the reel drum and connected to the line through canopy switch, snap switch, fuse and a permanent resistor.



TYPE YR-2 CONDUCTOR-CABLE REEL

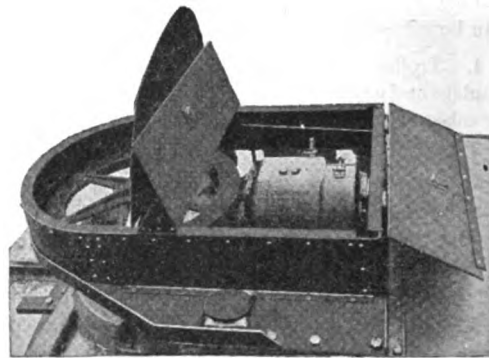
The reel drum is mounted in a horizontal position on the reel frame which is mounted on the locomotive. The drum is made of sheet steel of ample

strength and insulated with wooden strips around the entire periphery. These wooden strips protect the cable and also the drum.

The spooling device, or spooling bracket as it is called, consists of a casting which travels along the top guide bar and the lead screw at the bottom. The lead screw limits and reverses automatically the travel of the spooling bracket so that the cable is wound on the drum in even layers. The YR-2 reel is arranged to handle either single or double conductor cable by the use of different gear ratios.

### Traction-Reel Locomotives

The Westinghouse-Baldwin traction-reel locomotive has a motor-driven reel on which is wound a steel cable. The locomotive is stationed on the cross-entry track with the brakes set and the cable is taken into the room by a switchman who hooks the cable to a loaded car. The reel motor is then started and the car drawn out on the cross-entry track.



SHOWING MOTOR OF TRACTION-REEL

The traction reel is vertical and is driven by a motor through single reduction bevel gearing. It is very simple in construction, there being no clutch or other complications in the mechanism. The motor is of a type which has been giving satisfaction for years in the severest kind of service. It is operated through a speed-regulating controller mounted on the locomotive.

Traction reels can be arranged to pay cable out over the front or back end of locomotive as desired.

All parts are readily accessible and the armature can be removed without dismantling the reel.

### Storage Battery Locomotives

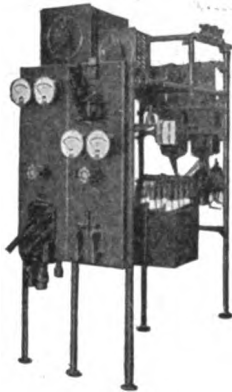
Storage Battery Locomotives can be supplied for all requirements. Following are the common standards:

Nominal Chassis Weight	Rated D.B.P.	Rated Speed in M.P.H.	Normal Battery Capacity in KW. Hours
6000	1000	3.5	11.4 to 22
8000	2000	3.5	23.0 to 35
10000	3000	3.5	36.0 to 48

The tables shown above list our standard sizes, but locomotives can be supplied in unusual sizes to meet the requirements of your particular application. Combination locomotives can be supplied in a range of sizes identical with trolley types.

## MINING SUBSTATIONS

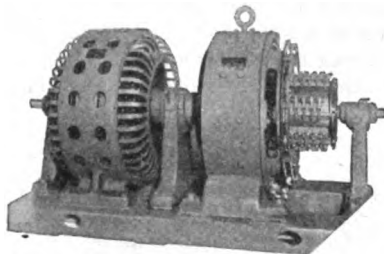
The two features essential to satisfactory operation of mining substations are thorough reliability and high efficiency. Westinghouse mine substation equipments fulfill these conditions.



STANDARD PANEL FOR 150 Kw. SYNCHRONOUS MOTOR GENERATOR FOR MINING SERVICE

The most important piece of apparatus in the substation is that used for transforming alternating current into direct current. This may be a synchronous converter or a motor generator.

In comparison with the motor generator, the synchronous converter has the advantages of higher efficiency, lower first cost and maintenance, and the smaller foundation and housing required. Westinghouse standard synchronous converters do not require synchronizing, and can be brought up to speed in 30 to 60 seconds. They will withstand one and one-half rated load for two hours without

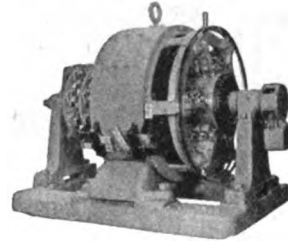


STANDARD 150 Kw. 1200 Rpm SYNCHRONOUS MOTOR GENERATOR

overheating. The d-c. end is designed to give 275 or 600 volts, as listed in the table of ratings. The a-c. end is connected six-phase diametrical and is regularly supplied for operation on 2300 volts, 3 phase, 60 cycles. With suitable transformers, operation can be obtained from any commercial voltage. Three single-phase type SKR transformers are ordinarily supplied with the synchronous converter. They are self-cooled, oil insulated, and of rugged construction throughout.

The principal advantages of the motor generator in comparison with the synchronous converter are its ability to improve the power factor, its greater stability on varying alternating-current line voltage

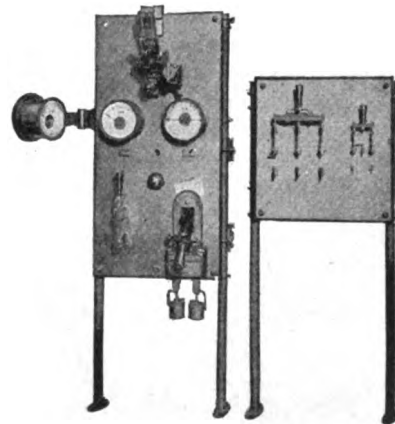
and frequency, and the wide adjustment of generated voltage which can be secured. Motor generators for mine service are supplied with a synchronous motor, mounted on a common bedplate and shaft with a compound-wound, commutating-pole generator arranged for either 275 or 600 volts.



STANDARD SYNCHRONOUS CONVERTER

The motor will operate successfully at rated load and frequency with voltage 10 per cent above or below the nameplate rating.

The switching equipment for mine substations should be selected only after a thorough and careful analysis of operating conditions has been made, as in many cases, the automatic switching equipment described on page 351 will effect savings. For the purpose of making such a study, the services of experienced Westinghouse engineers are freely at the disposal of the customer, and apparatus recommended under these conditions can be depended upon for maximum production and continuous economical operation.



STANDARD MINING TYPE SWITCHBOARD FOR SYNCHRONOUS CONVERTER

### Ratings of Synchronous Motor Generators

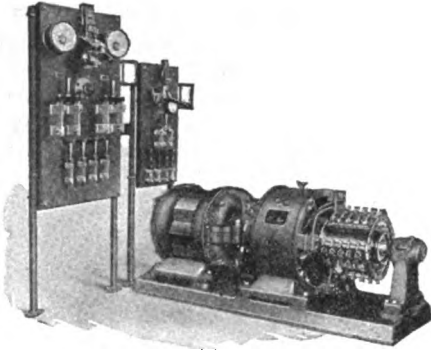
Kw. 40°	Generator		P.F. Motor	Kw. 40°	Generator		P.F. Motor
	Rpm	Volts			Rpm	Volts	
100	1200	275	80	200	1200	275	80
100	900	600	100	200	1200	600	80
150	1200	275	80	300	1200	275	80
150	1200	600	80	300	1200	600	80

### Ratings of Synchronous Converters A-C. Line Voltage 2300, 6600, 13,200

Kva.	D-C. Volts		Rpm
	275	600	
100	275	600	1200
150	275	600	1200
200	275	600	1200
300	275	600	1200
300	600	600	1200

M-168

## ELECTRIC ARC-WELDING



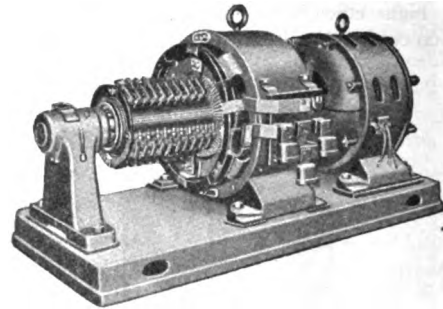
**300-AMPERE MULTIPLE OPERATOR UNIT WITH CLASS I PANEL AND TYPE A OUTLET**

Multiple Operator units are used for carbon electrode welding or for metallic electrode welding. The complete equipment consists of motor generator, welders' tools, generator control panel and necessary outlet panel. The type E portable panel provides for current values varying from 15 to 225 amperes. For complete information on the generator control and stationary outlet panels see Switchboard Section 2-A.

Electric Arc Welding has become an essential manufacturing process in the metal working industry and can be used efficiently and economically for repairing machinery and reclamation of worn parts in practically all mills and factories.

Two processes of arc welding are in general use—the metallic electrode and the carbon or graphite electrode process. In general the graphite electrode process is used for heavy cutting or for rapid deposition of metal. The metallic electrode process is best where strength and good physical characteristics of the deposited metal are essential. Metallic electrode welding requires in general current values ranging from 50 to 225 amperes and graphite electrode welding requires currents varying from 200 amperes to 800 amperes.

Electric arc welding processes have been used in the manufacture of electrical machinery by the Westinghouse Electric & Manufacturing Company for about twenty years. For more than fifteen years,

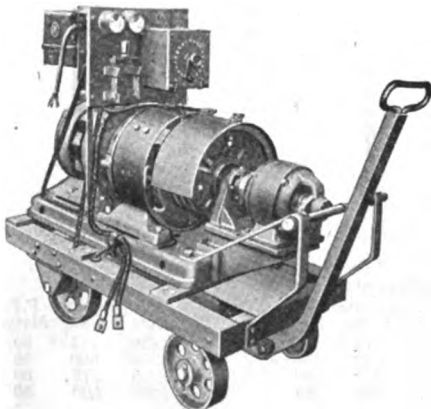


**1000-AMPERE A-C-D-C WELDING MOTOR GENERATOR SET**

the Westinghouse Electric & Manufacturing Company has marketed a complete line of electric arc welding equipment.

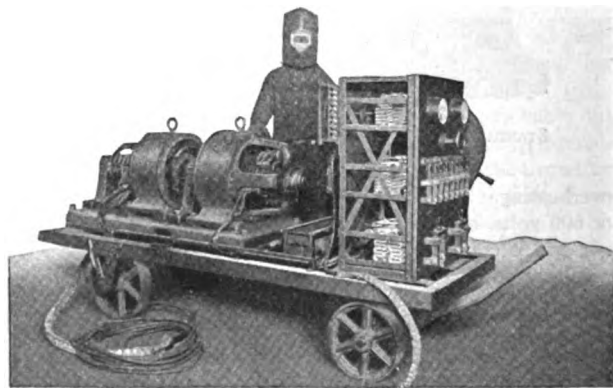
Capacities of Westinghouse arc welding motor generators range from the 175 ampere single operator equipment, for stationary or portable service, to the 1000 ampere equipment for supplying several operators using either the metallic electrode or the graphite electrode process. Larger sets can be built on special order.

Direct current is best for electric arc welding on account of the fundamental arc characteristics and phenomena involved in the deposition of metal through an electric arc. The voltage of the arc will vary from 18 to 22 volts depending upon the character of the work, length of the arc, etc. The motor generator affords the most simple and rugged means of converting the available power energy to direct current energy of suitable voltage and current characteristics for electric arc welding.



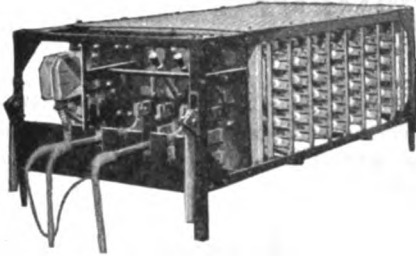
**175-AMPERE SINGLE OPERATOR, A-C-D-C MOTOR GENERATOR, PORTABLE TYPE**

This equipment supplies current for one operator varying from 90 to 225 amperes. This rating equipped with A-C. or D-C. motor drive, according to characteristic of supply circuit.



**300-AMPERE PORTABLE OUTFIT, DIRECT-CURRENT MOTOR DRIVE**  
300 and 500 Ampere Multiple Operator Equipments are often used as portable equipments. Panel shown above supplies control for two welding circuits, each having a range of values from 15 to 225 amperes.

## ELECTRIC ARC-WELDING—Continued



**Resistor Type Welding Unit.** Used in electric arc welding for reducing commercial direct current voltages to welding voltage. Equipment fitted with handles for carrying. Readily portable. Weight approximately 150 pounds.



Worn and broken parts of electric railway equipment reclaimed by electric arc welding. Electric arc welding equipment is an indispensable tool for steam and electric railroad shops. Running repairs, made without disassembly of parts, result in more mileage before heavy repairs are necessary.

Two classes of welding motor generator equipment are necessary to meet the requirements of efficient welding installations. These are single and multiple operator equipments. Either may be of the portable type except the larger rating of the multiple operator units.

The single operator equipment supplies welding energy to one operator only. The multiple operator equipments are so designed that a number of operators may work from the same power plant with all welding circuits in parallel. A separate control panel is used for each operator.

Where the work is light and readily transported to the welding shop, a central welding plant, with multiple operator equipment often shows advantages. If the work is scattered over a large area, or the maintenance of heavy machinery or equipment predominates, the portable type single operator equipment should be used. The portable equipments are entirely self-contained, and all that is necessary to start work is to connect to the available source of power supply.

Special motor generator equipments have been developed for street railway service. The motor is designed to operate over widely varying trolley voltage, approximately 350 to 650 volts.

Light weight resistance units are offered for reducing available direct current energy to arc voltage. This type of equipment can be used to advantage where welding is done only occasionally and an investment in the more efficient motor generator is not warranted.

A complete set of operators' welding accessories is shipped with each Westinghouse welding equipment.

Generators for belted service are standard in capacities corresponding to the capacities of the various motor-generators. Service requirements often demand an engine driven unit which may be used in places where no source of electric supply is available. These generators may be assembled with gas, oil or steam engines, and used in places where no source of electric power is available.

**Standard Ratings**

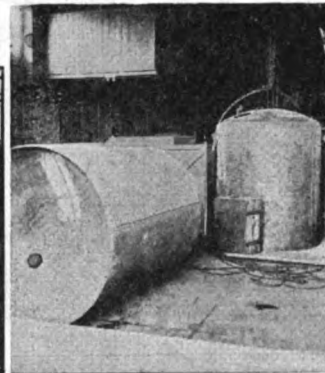
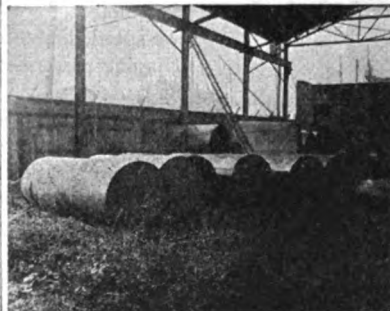
Single Operator Unit, 175 amperes, a-c. and d-c. motor drive  
Multiple Operator Sets, 60 volts, 60 cycles, 300, 500, 750 and 1000 amperes.

Multiple Operator Sets, 50-cycle, 60 volts, 300, 500, 750 and 900 amperes.

Multiple Operator Sets, 25-cycle, 300, 500, 750 and 1000 amperes.

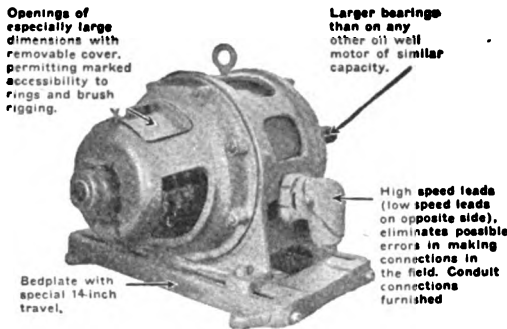
Generators for belted service or engine drive in all capacities corresponding to capacity of motor-generators as listed above.

Resistor Type Unit, 60 to 210 amperes.



Electric arc welding has reduced manufacturing costs in many metal working industries, particularly those engaged in the manufacture of tanks, containers and structural steel work. The cost is in almost every case less than when some other process is used. An improved product is obtained in addition.

## OIL WELL EQUIPMENT



The use of electrical apparatus in the Petroleum Industry is steadily increasing. This means not only that more operators are using electricity but also that new applications for electrical apparatus are constantly being found.

The more important uses now being made of electricity in the oil fields, and the apparatus that we can furnish to meet the requirements of the various applications, are as follows:

### Drilling

The two principal methods of drilling wells are the cable tool and the rotary methods. The former is the older and is still used in many parts of the country, though the rotary drill is rapidly coming into general use—especially in the West.

Many local conditions affect and determine the power requirements for drilling. However, we find that a large percentage of wells in territories that are now electrified can be drilled successfully and economically with one of the following equipments:

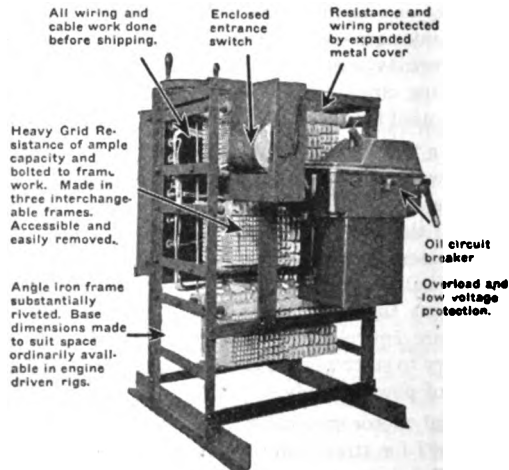
- 75 h.p.—10 pole—CW motor—3 ph. 440 volt—60 cy.
- 100 h.p.— 8 pole—CW motor—3 ph. 440 volt—60 cy.
- 100 h.p.—10 pole—CW motor—3 ph. 440 volt—60 cy.



The control consists of a primary controller, a secondary controller, circuit breaker, push button, ammeter, current transformer, and resistance to give fine steps of speed adjustment throughout a wide range of speeds.

### Pumping

Oil well pumping, probably more than any other oil field operation, is a duty that can be performed more satisfactorily and more economically with electrical apparatus than with any other kind of drive. This is due chiefly to the fact that in many cases pumping is a continuous 24-hour-a-day operation, and hence any shut down means a loss in production. At the same time any saving that can



be effected in fuel oil or in the time required for cleaning the well and pulling rods, means an increase in production.

For light wells we can furnish single-speed induction motors for driving unit pumping powers; or two-speed, double-rated induction motors for driving pumping powers that include hoisting drums. For pumping by means of pull-rods from a central power, we can furnish squirrel cage or wound rotor motors for driving the power head.

The largest field for electrifying producing wells is in the cases of wells that are pumped on the beam. A very large majority of such wells can be pumped satisfactorily and efficiently with our 35/15 HP two speed oil well pumping motor and unit control. This equipment not only has the necessary electrical characteristics for the service, but is also designed to make the installation and operation as easy for the average oil field man as it can possibly be made. The illustrations show the compactness and convenience of this apparatus.

## ELECTRIC FURNACES

Electric Furnaces are supplied in two types of construction, Multiple Unit and Hevi-Duty. The Multiple Unit uses a helical coil heating element and it is suitable for temperatures up to

1850 degrees F. The Hevi-Duty uses solid return bend coil heating elements suitable for temperatures up to 2000 degrees F.

### COMBUSTION-TYPE FURNACES



STANDARD COMBUSTION TUBE FURNACE, TYPE 77—SHOWN WITH ONE SPARE UNIT. HEIGHT TO CENTER, 10 INCHES



HINGED DESIGN, COMBUSTION FURNACE, TYPE 70—SHOWN WITH ONE SPARE UNIT. HEIGHT TO CENTER, 9 1/2 INCHES

Furnaces of this type, while designed primarily for combustion work, have been used extensively for enameling or hardening tubes, rods, helical springs, etc., and for pyrometer calibration.

#### Combustion Tube Furnaces

Type	Diam. Ins.	Length, Ins.	Volts	Kw.
70	1 1/4	12	110-220	.75
77	1 1/4	12	110-220	.56

#### Organic Combustion Furnaces

Type	Diam., Ins.	Length, Ins.	Volts
123	1 1/4	4-8-12	110-220
122S	1 1/4	3-6-8	110-220

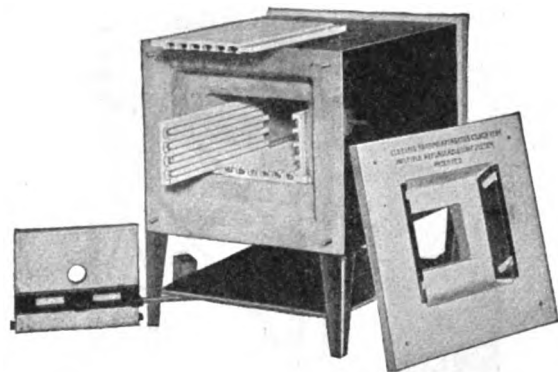
#### Hevi-Duty Combustion Furnaces

Type	Diam. Ins.	Length, Ins.	Volts	Kw.
HD99	1 1/4	10	110-220	7
HD595	2	10	210-220	3 4

### MULTIPLE UNIT MUFFLE FURNACES



INCASED-RHEOSTAT MUFFLE FURNACE—Types 60, 62, 64 and 66. Door, shown top-hinging, is reversible for bottom-hinging.



MUFFLE FURNACE—Open for renewal of units. Typical of all types.

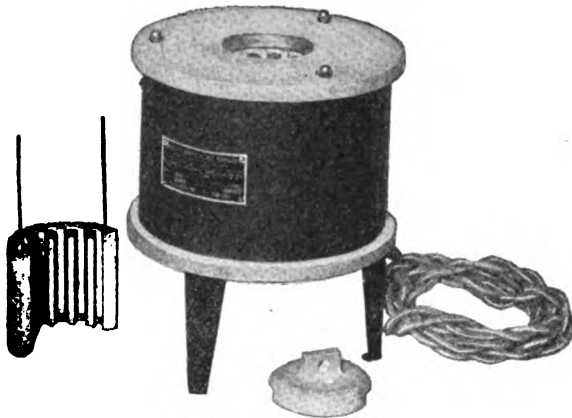
Type	INSIDE SIZES IN INCHES		
	Width	Depth	Height
50	3 1/4	7	2 1/2
52	4 1/4	10	3
54	5 1/4	12	3 1/4
56	7 1/2	14	5 1/4
60	3 1/4	7	2 1/2
62	4 1/4	10	3
64	5 1/4	12	3 1/4
66	7 1/2	14	5 1/4

Note: Always specify voltage when order includes rheostat.

110 Volts	RATING		Watts
	AMPERES		
9.1	4.55	1000	1000
13.1	6.55	1440	1440
18.8	9.4	2070	2070
31.0	15.5	3400	3400
9.1	4.55	1000	1000
13.1	6.55	1440	1440
18.8	9.4	2070	2070
31.0	15.5	3400	3400

KILOWATT-HOURS	
In Reaching	Holding
1400° F.	1400° F.
(760° C.)	(760° C.)
from 75° F.	per Hour
.5	.39
.72	.89
1.2	1.37
2.0	2.5
.5	.39
.72	.89
1.2	1.37
2.0	2.5

**ELECTRIC FURNACES—Continued**  
**CRUCIBLE FURNACES**



CRUCIBLE FURNACE, TYPES 80, 82, 84 AND 86—  
shown with one spare unit.

This form of furnace is used extensively for melting small quantities of base metals; for pyrometer calibration when couples are immersed in molten salts or metals; and for decalescent work in steel.

**Temperatures**—All crucible furnaces have a safe working temperature of 1832° F. (1000° C.) for continuous duty, and a maximum temperature of 2000° F. (1095° C.) for comparatively short periods on intermittent work.

Type	Voltages	Watts	DIMENSIONS IN INCHES				WEIGHT IN POUNDS			
			Inside Diam	Deep	OVERALL		NET		BOXED	
					Diam.	High	Furnace Only	Rheostat Only	Furnace Only	With Rheostat
80	110	390	2 3/4	2 1/4	7 3/4	8 1/2	9	4	16	20
80	220	780	2 3/4	2 1/2	7 3/4	8 1/2	9	7	16	30
82	110 & 220	484	2 3/4	4	7 3/4	10	10	4	22	26
84	110 & 220	550	3	3 1/2	8 3/4	11	13	4	25	29
86	110 & 220	725	3	5	8 3/4	12 1/4	15	4	30	34

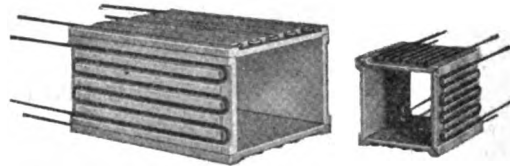
NOTE: Always specify voltage when order includes rheostat.

**SMALL HEVI-DUTY FURNACES**  
**MUFFLE AND CRUCIBLE TYPES**  
For Operation Continuously at 2000° F. (1100° C.)



TYPE HD122 MUFFLE FURNACE. Complete with regulating transformer. Types HD128 and HD136 are similar in appearance, but are deeper.

These furnaces can be sold to tool manufacturers' tool rooms in every industrial plant, machine shops in industrial plants, repair shops of all kinds, hardware manufacturers, watch and clock manufacturers, telephone manufacturers, instrument manufacturers, and manufacturers of small vitreous enamel parts such as signs, nameplates, etc.



Set of Type HD96 muffle plates with return-bend coils — characteristic of all muffle furnaces.

Set of Type HD46 crucible plates with return-bend coils — characteristic of all crucible furnaces.

All return-bend coils forming the heating elements are supported by means of grooves in the unit refractories. Each heating coil has only two terminals extending through to the outside of rear head. The maximum percentage of the heating element is entirely within the furnace chamber.

**Hevi-Duty Muffle Furnaces**

Type	INCHES			Kw.
	Width	Height	Length	
92	4	3	10	1.7
96	8	5	12	4.3
114	12	6	14	6.8
122	12	8	22	11.0
128	12	8	28	13.0
136	12	8	36	15.0

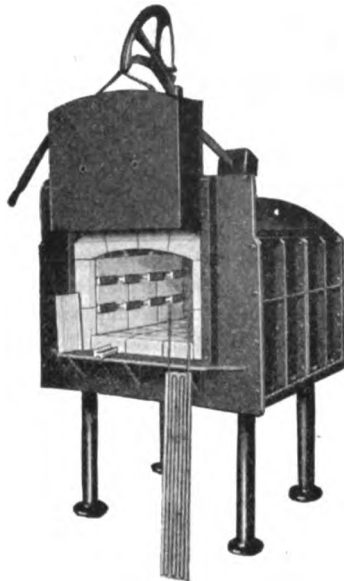
**Hevi-Duty Crucible Furnaces**

Type	INCHES			Kw.
	Width	Height	Depth	
HC46	4	4	6	2.2
HD710	7	7	10	4.0
HD1014	10	10	14	7.0

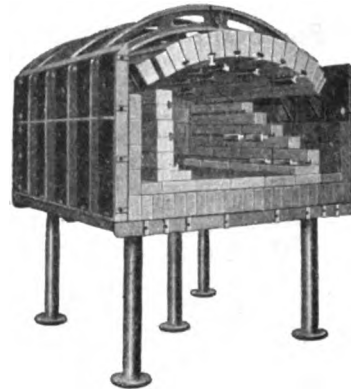


ELECTRIC FURNACES—Continued

HEVI-DUTY FURNACES

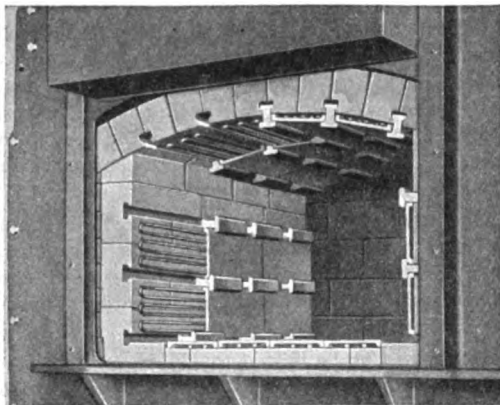


SINGLE END HEVI-DUTY FURNACE



TYPE HD3641, SINGLE END, 32x16x48 INCHES, IN PROCESS OF CONSTRUCTION

Bottom insulation in place and part of side wall insulation. Part of right hand side wall tiles removed, exposing arch supported on cast-iron brackets attached to cast-iron side plates. Brick insulation of side walls does not extend above the height shown in brick insulation at left hand side. The entire arch and down to the side wall brick insulation (with the exception of the 4 1/2-inch course of brick insulation placed at top ends of arch) is filled with powdered diatomaceous earth. Photo exposes the cast-iron roof arches rigidly maintaining cast-iron side plates in alignment. The stand supporting the door segment is rigidly fastened to the front or end roof arch.



TYPE HD2631, FACING ARCH REMOVED, EXPOSING ARCH AND SIDE WALL TILES. Muffle Plates removed from front end of two top coils and front end of two side coils, exposing coils in place, typical of all sizes.

heating elements, are made larger and heavier to provide ample safety factor, and consequently long life of operation, as required in industrial plant operations.

Heating elements completely surround the furnace chamber, top, floor and sides, thereby obtaining uniformity of temperature, speed of operation, and efficiency unattainable with any other furnace on the market.

General Application

**Annealing furnaces** for carbon steel, high-speed steel, alloy steel, copper, zinc, aluminum, and glass.

**Hardening furnaces** for carbon steel and alloy steel.

**Drawing furnaces** for carbon steel, alloy steel, and high-speed steel.

**Vitreous enameling furnaces** for sanitary ware, chemical tanks and fittings, metal signs, kitchen utensils, stove parts, hardware, and chemical processes.

HEVI-DUTY Industrial Furnaces have heating elements of relatively same construction as small HEVI-DUTY furnaces, but the parts, including the

APPROXIMATE WEIGHT, POUNDS

Type	Style	INSIDE DIMENSIONS INCHES			KW Capacity	TRANSFORMER AND CONTROL COMPLETE*			
		Width	Length	Height		Net	FURNACE Shipping	Net	Shipping
HD1321	Single End	18	24	13 3/4	22.66	3735	4000	686	1000
HD1331	Single End	18	36	13 1/2	29.88	4650	4900	797	1160
HD1341	Single End	18	48	13 1/2	40.60	5550	5850	1024	1400
HD1361	Single End	18	72	13 1/2	57.75	7100	7650	1250	1765
HD2631	Single End	25	36	16	35.86	5300	5650	949	1290
HD2641	Single End	25	48	16	48.72	6300	6700	1080	1610
HD2661	Single End	25	72	16	69.30	8325	8925	1510	2300
HD3641	Single End	32	48	16	56.84	7200	7650	1320	2300
HD3661	Single End	32	72	16	80.85	9500	10200	1945	2735
HD1362	Double End	18	72	13 1/2	57.75	7200	7750	1266	1780
HD2662	Double End	25	72	16	69.30	8375	8975	1510	2300
HD3662	Double End	32	72	16	80.85	9500	10200	1945	2735

\*Approximate weights for three single phase 220-440 volt, 60 cycle transformers, and three-phase contactors on 220 volts, open type.

## AUTOMATIC ELECTRIC BAKE OVENS

For Commercial Baking of Bread, Pies, Cakes and Pastries

### SECTIONAL-TYPE BAKE OVEN



180-LOAF THREE-SECTION OVEN—60-LOAVES PER SECTION

The sectional type automatic bake ovens are built on the principle of the "Sectional Book Case" — one section for the small bakery and two or more sections for the larger bakery. This permits the purchase of as many sections as are needed for the initial demands of the baker's business and then the

purchase of additional units as the business grows and more output is needed. These ovens are used for baking of bread, pies, cakes, pastries and other sweet goods. The hearth tile permits the baking of hearth bread as in the old brick ovens.

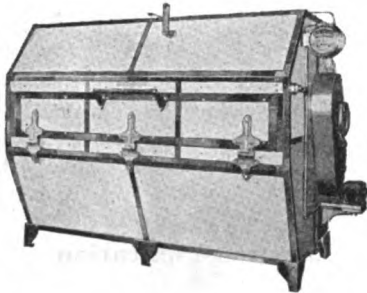
**Size of Ovens**—The two standard oven units are:

20 loaf section (one pound loaves)

60 loaf section (one pound loaves)

**Automatic Control**—Each section is equipped with a motor-operated snap switch and electric contact control thermostat for maintaining the temperature at any point desired. The 20-loaf section has one motor-operated snap switch and the 60-loaf section has two motor-operated snap switches mounted on the right side panel of each section. The thermostat is adjusted by means of a small arm projecting through the metal box on the side of the oven. The thermostat can be adjusted over a temperature range of 300 to 500 degrees, Fahrenheit.

### REEL-TYPE BAKE OVEN



AUTOMATIC ELECTRIC REEL TYPE BAKE OVEN FINISHED IN WHITE VITREOUS ENAMEL TRIMMED WITH NICKEL

**Application**—Baking of bread, cakes, pies, pastries, etc.

**Construction**—Shelves, hung on a revolving reel, form the baking surface. Door when open forms a convenient shelf for loading and unloading. A one-sixth horse-power motor revolves the reel and shelves. The oven is built of heat insulating material between sheet steel panels finished in white enamel with nickel frame.

**Operation**—Push button on oven starts the oven to heating and tumbler switch starts the motor. Thermostat with proper setting determines the temperature in the oven which is maintained automatically.

**Heating**—Can be heated to 450 degrees Fahrenheit in 45 minutes. Temperature range is 300 to 500 degrees Fahrenheit.

### CONTINUOUS CONVEYOR-TYPE BAKE OVEN

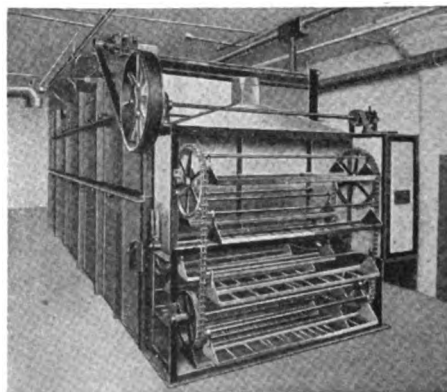
This type of oven is intended for use in large wholesale bakers and bakeries for chain stores, when a much greater capacity is required than can be handled by the reel-type oven.

Ovens are made in five sizes: 400, 600, 800, 1000 and 1200 loaf sizes. Ovens can be supplied single end loading and unloading and double end loading and unloading.

Ovens are constructed of heat insulated panels and are finished in galvanized iron.

Automatic temperature control and adjustable speed regulation is supplied.

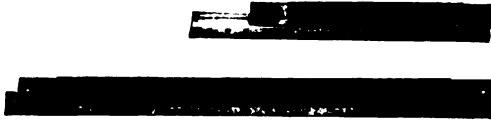
The ovens can be heated to a temperature of 450° Fahrenheit in 45 minutes. Temperature range is 300 to 500° Fahrenheit.



No. 3 CONTINUOUS CONVEYOR BAKE OVEN, CAPACITY 1200 ONE AND ONE-HALF POUND LOAVES PER HOUR

M-165

## INDUSTRIAL HEATING APPLIANCES

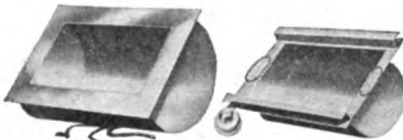


STANDARD 12- AND 24-INCH SPACE HEATERS

**Space Heaters**—Space heaters are made in three standard sizes: 12-inch rated 220 watts; 24-inch rated 500 watts and 44-inch rated 1250 watts. The enclosed element feature makes them absolutely safe from fire hazard. Maximum temperature is 800° F.



**Electric Steel-Clad Heaters**—Enclosed element steel clad heaters with single end terminals are used in mold drying machines and composition molding presses. It is a flat heater which can be mounted against any metallic surface or imbedded in platen plates. Maximum temperature is 450° F.



ELECTRICALLY HEATED CHOCOLATE WARMER

**Chocolate Warmers**—Chocolate Warmers used in heating of chocolate in manufacture of all kinds of chocolate candy, insure a uniform temperature at a very low cost and with maximum cleanliness and sanitation. Chocolate Warmers are made in 6 and 10-quart sizes with three-heat temperature control.



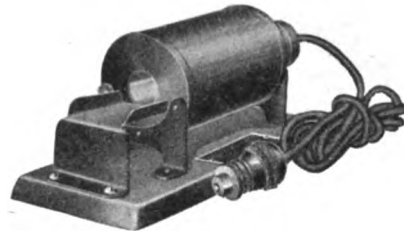
ELECTRICALLY HEATED GLUE POT

**Glue Pots**—Electric Glue Pots with rheostatic temperature control insure correct glue temperature because there are approximately 300 steps on the controlling rheostat. Glue pots are made in 1-pint, 1-quart, 2-quart and 4-quart sizes. The copper glue vessel is separate from glue pot and can be removed for cleaning.



CARTRIDGE TYPE HEATER

**Cartridge Heaters**—Special applications where heat is required in metal platens use cartridge heaters in large quantities. The rubber industry and cigarette manufacturers find these heaters very satisfactory for obtaining the proper amount of heat at concentrated places.



TUBE FURNACE

**Tube Furnaces**—Tube Furnaces are used for heating small soldering irons and calibrating pyrometers. They are also very handy heaters for jewelers, silversmiths, chemists and telephone repair shops. They are manufactured in one inch and two inch sizes, 150 and 750 watts respectively. The maximum temperature obtainable is 1600° F.

**Grid Heaters**—Immersion element grid heaters for heating oil tempering tanks are usually mounted in the bottom of the tank. They are also applied to the manufacture of paints and oils. Automatic control can be supplied with such applications. Maximum temperature is 700° F.



30-POUND SOLDER POT

**Solder Pots**—Solder Pots are used for melting solder, babbitt, tin, lead and other similar metals. They are made in 10-pound, 30-pound, 150-pound and 750-pound sizes. The first two sizes have three-heat control while the last two are equipped with automatic temperature control.

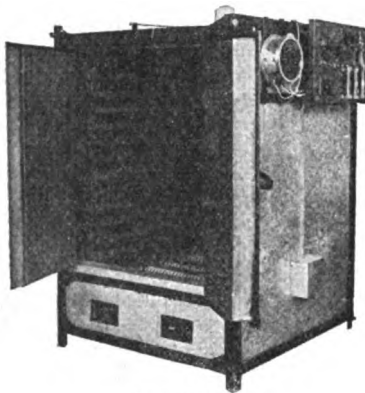
## INDUSTRIAL ELECTRIC OVENS

Westinghouse industrial ovens are used for baking japans and enamels, armature baking, corebaking, and drying and evaporating processes.

Ovens can be supplied complete with heating equipment and control, or the heaters and control alone can be furnished for installing in the users oven.

assembled by the user. Automatic control and a motor driven ventilating system is standard with all these ovens.

Types M-107, M-109 and M-114 are particularly adapted to armature baking.

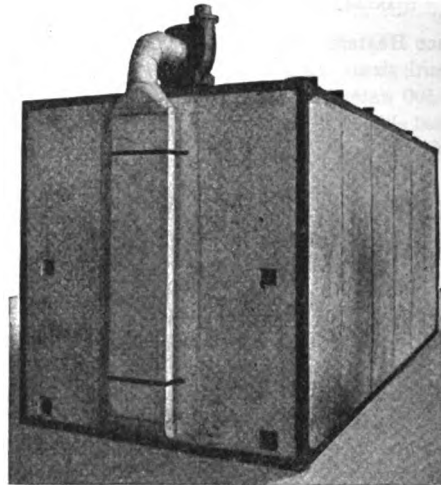


TYPE K-30 OVEN

**Type K Ovens** are the box type and are shipped completely assembled.

Sizes K-0 and K-10 are equipped with 3-heat snap switches and all other sizes with automatic temperature control.

Type	Inches Insulation	SIZE (INSIDE) IN INCHES H W D
K-0	1	12x12x16
K-10	2	30x24x24
K-30	3	38x32x35
K-40	3	38x32x35
K-50	3	44x48x36
K-60	3	60x66x36



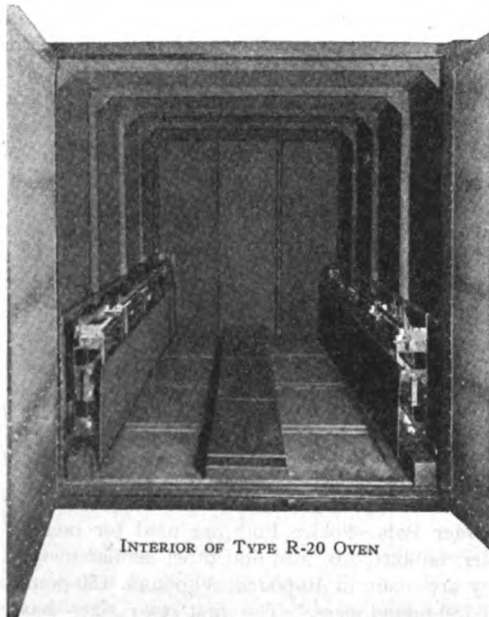
TYPE M-109 OVEN REAR VIEW

Type	Inches Insulation	SIZE (INSIDE) IN FEET H W D
M-107	2 or 4	6 1/2 x 6 x 7
M-109	2 or 4	6 1/2 x 6 x 9 1/2
M-114	2 or 4	6 1/2 x 6 x 14 1/2
M-207	2 or 4	6 1/2 x 8 x 7
M-212	2 or 4	6 1/2 x 8 x 12
M-219	2 or 4	6 1/2 x 8 x 19 1/2
M-312	2 or 4	9 1/2 x 8 x 12
M-319	2 or 4	9 1/2 x 8 x 19 1/2
M-324	2 or 4	9 1/2 x 8 x 24 1/2

**Heaters**—Type C oven heaters were designed for oven heating but they have been very successfully applied to air-heating for factories.

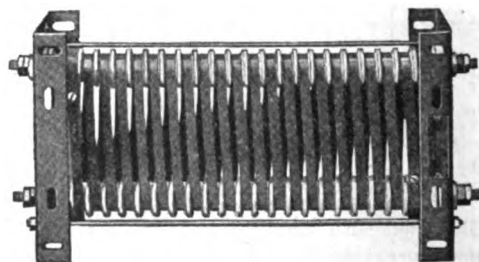
The open coil allows free air circulation and the tie rods, being the heater terminals, allow connection to be made at either end. A full line of standard connectors makes installation easy.

The heater is built in 1.75 and 2.5 kw. ratings on 110 volts and 3.5 kw. and 5 kw. ratings on 220 volts.



INTERIOR OF TYPE R-20 OVEN

**Type M Ovens** are of sectional construction so as to be shipped knocked down and easily re-



TYPE C OVEN HEATER

**Control**—Automatic control equipment consists of a control panel and thermostat. The control panels have ratings from 60 to 400 amps. for operation on all commercial power circuits.

M-167

## DIRECT-CURRENT CONTROL

### MANUALLY-OPERATED STARTING AND SPEED CONTROL RHEOSTATS

**Type D starting rheostats** (class 7010) are used for starting shunt, compound and series-wound direct-current motors up to 55, 125 and 105 hp. for 115, 230 and 550 volts respectively. These starters are characterized by strong compact, fire-proof construction and have the approval of the National Board of



TYPE D RHEOSTAT WITH BAR RESISTOR

Fire Underwriters. They are self-contained, consisting of a face-plate with renewable segments, low-voltage release mechanism and self contained resistance. In the smaller sizes tube and bar resistors are employed, while, in the larger ratings, the grid type resistor is used. Each part is readily accessible for inspection and all wearing parts can be easily and cheaply renewed.

**Type DM mine duty rheostats** (class 7010) are designed for use in mines and other places where the apparatus is subjected to dampness. They are built in the same capacities as the type D and the current carrying parts are thoroughly protected against injury from the presence of moisture or acid fumes.

**Type DS starting panels** (class 7015) consist of a type D starter and a line switch with fuses mounted on a slate base. The panels may be mounted either

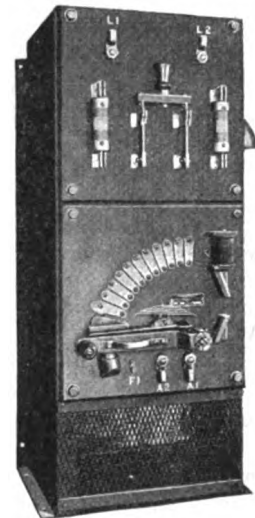


RHEOSTAT WITH SAFETY COVER

on the wall by means of brackets or on pipe frame supports for bolting to the floor.

**Type H speed control rheostats** (class 7020) are used for starting and regulating the speed of direct-current motors in non-reversing service where speed adjustment by field control is desired. They are built in capacities up to 55, 120 and 85 hp. for 115, 230 and 550 volts respectively. The apparatus is so arranged that the motor is always started with full field strength. In case of failure of the voltage the field control resistance is automatically short-circuited and the motor is disconnected from the line. The rheostats are self-contained, consisting of a face-plate with renewable segments, low voltage release mechanism and self-contained field and starting resistance. Each part is readily accessible for inspection and all wearing parts can be easily and cheaply renewed.

**Type DA speed control rheostats** (class 7030) are used for reducing the speed of shunt, compound and series wound direct-current motors by armature control. They are built in capacities up to 20, 40 and 40 hp. for 115, 230 and 550 volts respectively and consist of a face-plate with renewable segments, low-voltage release mechanism and self-contained resistors. Each part is readily accessible for inspection and all wearing parts can be easily and cheaply renewed. There are two classes of non-reversing service for which these rheostats are suitable—namely, varying torque and constant torque. Fans, blowers, centrifugal pumps, etc., come under the first heading; in this service the torque decreases with the speed but remains constant at any given speed. Machine tools, job printing presses, plunger pumps and similar applications are in the second class; in this service the torque is independent of the speed. Constant speed with varying torque cannot be obtained with these rheostats.



TYPE DS STARTING PANEL

## DIRECT-CURRENT CONTROL—Continued

**Safety covers** (Class 7060) are used for completely enclosing the face-plate of Types D, DM, H, DA, and I Westinghouse starting and speed control rheostats. These covers not only protect the face-plate and the contacts from flying chips and other foreign material, but also protect operators and

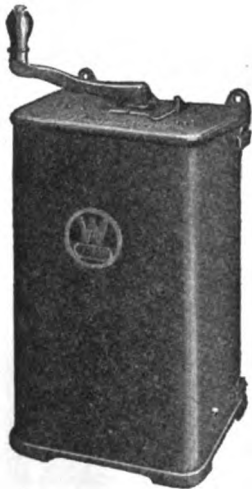
surrounding materials from accidental contact with live parts. They are not only applicable to new rheostats, but may be readily applied to rheostats already in service.

Complete descriptions of these controllers will be furnished on request.

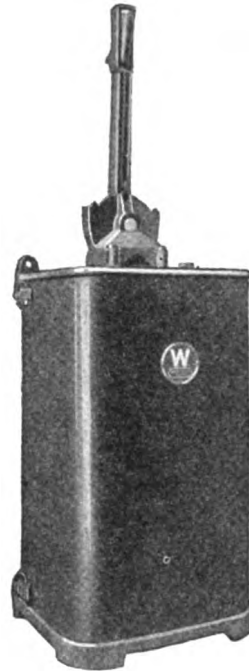
## MANUALLY-OPERATED STARTING AND SPEED CONTROL

**Type S drum-contactor controllers** (class 7100) are used for starting and adjusting the speed of shunt, series and compound-wound direct-current motors by adjusting the resistance in series and parallel with the motor armature. They are applicable to cranes, hoists, crushers, floor chargers, roll and transfer tables, punches and practically all applications employing this system of control. They are suitable for controlling motors up to 37, 75 and 125 hp. for 115, 230 and 550 volts respectively.

Contacts, which are practically the only wearing parts, are interchangeable with those of Westinghouse auto starters and magnetic contactor controllers. In addition to the accessibility of all parts,



TYPE S CONTROLLER WITH  
HORIZONTAL HANDLE



TYPE S CONTROLLER WITH  
VERTICAL HANDLE

These controllers are successful under the most severe operating conditions. They combine many of the advantages of magnetic contactor controllers with small size, simple construction and low cost. A few of the outstanding advantages of these controllers are:

Longer life than any other manually operated controller of equal capacity.

The initial cost is but slightly greater than that of other types of manually operated controllers.

Easy operation—contactors actuated by cams operating on rollers with little friction.

Increased contact life—rolling contacts together with quick operation, almost too quick for the eye to follow, reduces arcing and confines it to the contact tips, where current is carried only momentarily.

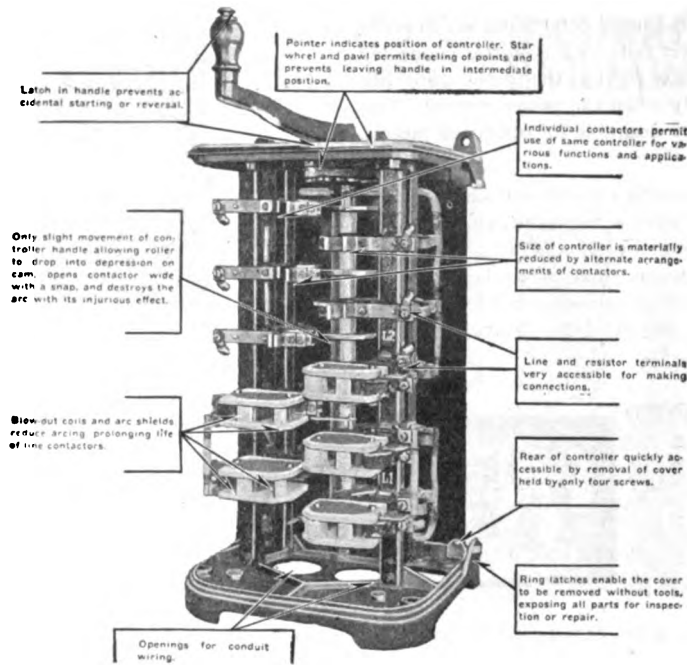
Contacts can be renewed in shorter time and at less expense than those on existing drum controllers.

Contact pressure is always uniform.

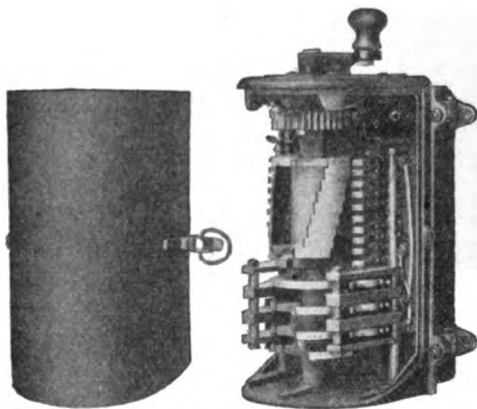
both moving and stationary contact elements can be taken out as units by removing one or two screws.

In operation, these controllers employ the same principles as magnetic contactor controllers, except the contactors are operated by cams mounted on the controller shaft. Normal movement of the controller handle causes the contactors to open or close with a quick positive action, which reduces arcing. The arcing is further controlled by the rolling motion of the contacts, which limits all arcing and burning to the contact tips. Consequently, there is no pitting, roughing or burning of that part of the contact where a load current is carried. Final contact is made with a slight wiping motion, which insures clean contact surfaces, and maximum current carrying capacity. The line contactors, which open and close the main line circuit, are protected by magnetic blow-outs, which aid in extinguishing any arcing that may occur. All contacts are spaced so that arc shields can be added when desired.

## DIRECT-CURRENT CONTROL—Continued



TYPE S CONTROLLER—COVER REMOVED



TYPE V-5 CONTROLLER FOR ADJUSTABLE-SPEED MOTORS IN MACHINE-TOOL SERVICE

Controllers employ all safety-first features, such as conduit wiring, enclosed current-carrying parts, protection against controller being locked in running position, and prevention of accidental starting or reversing. Type S Controllers are supplied both with and without dynamic braking.

**Machine tool drum controllers** (Class 7140) including types V-5, V-4, 245 and 246, are designed for use with shunt and compound-wound direct-current motors up to 50 hp., 230 and 550 volts in machine tool and similar reversing service, requiring speed adjustment by field control. Sturdy construction insures long life and the design is such that the operation is extremely easy and accurate. The movement of a single handle starts the motor in either direction of rotation and brings it to the desired speed. All parts are readily accessible for inspection and all wear is confined to substantial pieces which can be quickly and inexpensively renewed.

**Dynamic braking** with the operating handle in the off position can be supplied when desired.

## AUTOMATIC STARTING AND SPEED CONTROL

Westinghouse type C automatic starters constitute the ideal form of starting for direct-current motors, giving them perfect protection from excessive current during the starting period and eliminating the uncertainty and inefficiency of hand operated starters.

The personal factor of the operator loses its influence when the motors are started with automatic starters; there is no loss of time through over-cautiousness, nor burned-out motors from the impatience of the operator. He simply operates the

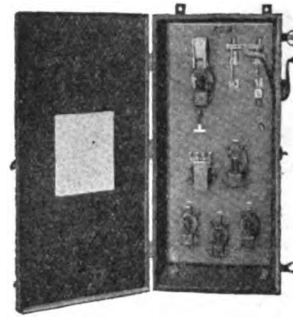
push button or other type of master switch, and the motor is started with the maximum speed consistent with safety. If these starters are used with a float switch, or pressure gauge, they will automatically maintain a predetermined pressure or liquid level. The starters are so simple that wrong operation is impossible.

These starters are used with motors driving machine tools, wood-working machines, pumps, compressors, blowers, etc., and all are supplied for both low-voltage release and protection connections

DIRECT-CURRENT CONTROL—Continued

and the master switch used determines which is obtained. If the power fails with a starter connected on low-voltage release service, the motor stops, but starts automatically when the power returns. This arrangement is very desirable for operating pumps, compressors, etc.

If the power fails with a starter connected for low-voltage protection service, the motor stops and can be only started again by the operator closing the starting switch. Hence, there is no danger to operator or expensive machinery from the unexpected starting of the machine. Starters for ma-

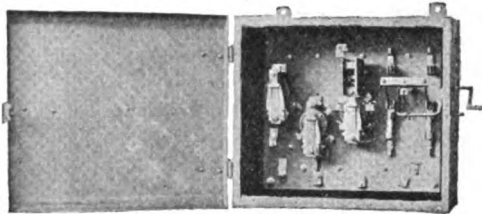


TYPE C NON-REVERSING AUTOMATIC STARTER

drum reverse switch or by a full magnetic reversing starter and a reversing master switch.

Speed control may be obtained by the use of an automatic starter and a separately mounted enclosed field rheostat, or the field rheostat may be combined in one unit with a reverse or master switch. The latter combination is exceptionally desirable for such applications as lathes, where it is desirable to obtain complete control of the motor from one handle or from the lathe apron by means of the spline shaft.

Enclosing Covers—All controllers can be furnished complete with dust-proof enclosing covers.



TYPE C NON-REVERSING AUTOMATIC STARTER

chine tools and woodworking machines are equipped with low voltage protection.

Standard controllers can be furnished for practically all applications. The table below will serve as a ready reference to the most active lines.

All starters automatically accelerate the motor at the proper rate. The rate of acceleration depends upon the load on the motor, that is, the lighter the load the less time required for the motor to accelerate to full speed. Overload protection may be provided either by an inverse time limit overload relay, or by knife switch and fuses mounted on the control panel.

Reversing may be obtained either by the use of a standard non-reversing automatic starter and a



TYPE C REVERSING CONTROLLER PROVIDING DYNAMIC BRAKING AND OVERLOAD PROTECTION

KEY TO CONTROLLER CLASS NUMBERS

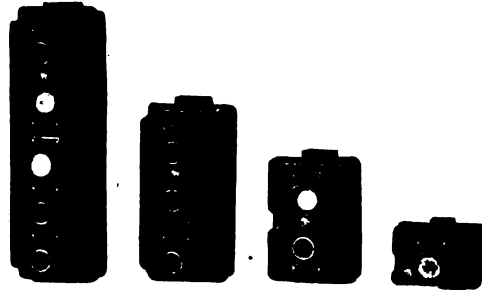
Hp.	NON-REVERSING		OVERLOAD PROTECTION BY		REVERSING	
	WITHOUT OVERLOAD PROTECTION Without Knife Switch	WITH OVERLOAD PROTECTION With Knife Switch	Knife Switch and Fuses	O. L. Relay	OVERLOAD PROTECTION BY Knife Switch and Fuses	O. L. Relay
			<b>CONSTANT SPEED</b>			
1-10	7423	7425	7405	7427	7429	7455
11-50	7423	7425	.....	7427	7429	7477
			<b>ADJUSTABLE SPEED</b>			
1-10	7523	7525	7505	7527	7529	7555
11-50	7523	7525	.....	7527	7529	7577



## ALTERNATING AND DIRECT-CURRENT AUTOMATIC CONTROL AUXILIARIES



TYPE CA PUSH-BUTTON STATIONS



TYPE C PUSH-BUTTON STATIONS

**Type CA push buttons** (Class 9420) are used in connection with alternating and direct-current automatic starters and controllers to control their various functions. They act as a master controller and allow the operator to slow down, speed up, stop and reverse the motor provided the controller is arranged for the particular operation desired. These stations may be made up of one box containing from one to six buttons depending on the functions desired, and can be mounted on the driven machine or any other convenient place. All stations are arranged for conduit wiring.

These buttons are rugged in construction, being designed for continuous operation and are finished very nicely and present a pleasing appearance. Their capacity is 10 amperes 550 volts, a-c. and  $\frac{3}{4}$  ampere 250 volts a-c.

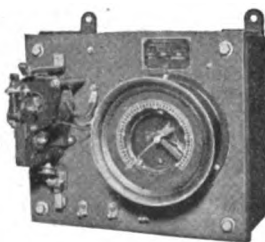
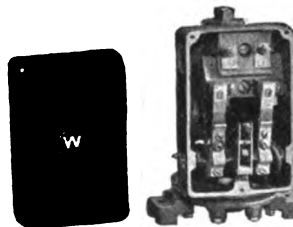
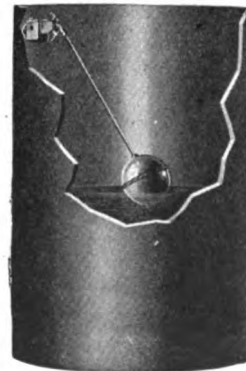
**Type C push button stations** (Class 9420) are used where an exceptionally rugged and large capacity station is needed. They are made to cover the same line of operations and functions as the type CA stations. Their capacity is 30 amperes 550 volts a-c. and  $5\frac{1}{2}$  amperes 250 volts, d-c.

**Pendant Switch**—These stations can be arranged for pendant switch operation by the addition of a standard box connector as handled by many dealers.

**Gauge-type pressure regulators** (Class 9435) are used with alternating and direct-current automatic starters used in connection with compressors or pumps emptying into a closed pressure system. This regulator makes connections to start the motor when the pressure falls to a predetermined point and stops it when the desired maximum is reached.

**The diaphragm type regulator** (Class 9450) is a pressure controlled switch for automatically maintaining pressure or liquid within predetermined limits by starting and stopping a motor driven compressor or pump. This regulator is double pole and will open both sides of a d-c. or a single phase a-c. motor or 2 wires of a 2 or 3 phase a-c. motor. It starts the motor by connecting it directly to the line and an additional starter is not necessary within the capacity of the switch. It is designed for operating in connection with machines emptying into closed pressure systems containing air, gas, water or any fluid not injurious to the rubber diaphragm. In pressure systems containing oil, steam, or ammonia, a loop should be introduced in the pipe to prevent the liquid or gas from coming in contact with the rubber diaphragm.

**Enclosed float switches** (Class 9425) are used with motor driven pumps to automatically prevent the liquid from falling below or rising above a certain predetermined level in open tank, reservoir, or sump systems. They may be used to connect any of the following single-phase motors directly to the line,  $\frac{3}{4}$  hp., 110 volts,  $1\frac{1}{2}$  hp., 220 volts, and 3 hp., 440-550 volts. They have a maximum current carrying capacity of  $\frac{3}{4}$ -ampere direct current, and ten amperes alternating current, and may be used in conjunction with automatic starters to control alternating or direct-current motors of any size.

GAUGE TYPE REGULATOR  
WITH RELAY (CLASS 9435)DIAPHRAGM TYPE REGULATOR  
(CLASS 9450)FLOAT SWITCH FOR OPEN TANK SYSTEMS  
(CLASS 9425)

M-150A

## ALTERNATING AND DIRECT-CURRENT AUTOMATIC CONTROL AUXILIARIES—Continued



TYPE 817-R AND M DRUM REVERSE SWITCH WITH FIELD REGULATION

**Combined Drum Reverse Switch and Field Rheostat Types 817-R, 245-C and 819**—These switches combine in one unit the reversing contacts, field regulating points and field resistors. They are used in conjunction with constant speed non-reversing starting panels which provide automatic acceleration, low voltage protection and other protective features. By the use of these switches the complete control of the motor can be obtained from one handle or the spline shaft of the driven machine. No full field relay is required, as motor always starts with full field.

**Combined Drum Master Switch and Field Rheostat Types 817-M, 812-M, 820**—These switches combine in one unit the master contacts, field regulating points and field resistors. They are used with full magnetic reversing control panels which provide reversing, automatic acceleration, low voltage and other protective features. By the use of these master switches the complete control of the motor can be obtained from one handle or the spline shaft of the driven machine. No full field relay is required, as motor always starts with full field.

**Drum Reverse Switches Types 809, 810 and 818**—These switches are used with non-reversing start-



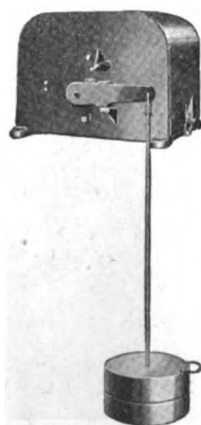
TYPE 810 DRUM REVERSE SWITCH

ing panels as masters and to obtain reversing, dynamic braking and drift. The reversing and dynamic braking are taken care of on the drum switch while the automatic panel gives automatic acceleration and provides overload, low voltage and other protective features.

**Type 809 master switches** may be used with alternating and direct-current magnetic controllers to provide start, stop and reverse. They are some times more desirable where it is not convenient to use a push button station, or where it is desired to control the motor from the spline shaft of the driven machine.

The crane hoist safety limit switch has been designed for use on the hoist motion of cranes and similar applications to prevent accidents caused by over-travel of the hoist block with the consequent expense and loss of production due to broken cables, blocks, and drums. By the use of this device the operator is also freed of the necessity of constantly being on his guard against running in the upper limits of the crane, as, regardless of the speed at which the crane block operates the limit switch, the block is brought quickly to rest by means of dynamic braking as soon as the limit switch operates. The switch contacts are of the rolling type with magnetic blowouts and arc splitters which insures long contact life.

The type S master controller is a small size type S drum-contactor controller and consequently incorporates all its splendid mechanical and electrical features. These master controllers are particularly recommended for severe service, and can be supplied with either vertical or horizontal handles. For a more detailed description, see type S drum controllers described on page 1248.



TYPE LC CRANE HOIST SAFETY LIMIT SWITCH WITH COUNTER WEIGHT



TYPE S MASTER CONTROLLER

M-151A

## STARTERS FOR SINGLE-PHASE MOTORS

### MANUAL

**Type DR starting rheostats** are used for starting single-phase, repulsion-type motors from  $\frac{1}{2}$  to 10 hp., for 110 and 220 volts and all commercial frequencies. These starters provide a smooth start and reduce the starting current by inserting resistance in series with the primary winding. They are self-contained and consist of a face-plate with re-



TYPE DR STARTING RHEOSTAT

newable segments, low-voltage release mechanism and resistor mounted within the starter box. They are characterized by strong, compact and fire-proof construction and have the approval of the National Board of Fire Underwriters. Each part is readily accessible for inspection, and all wearing parts can be easily and cheaply renewed.

Safety enclosing covers, which protect the operator from accidental contact with live parts and the starter from flying chips, etc., can be supplied for all sizes of starters.

**WK-10 and WK-20 motor starting snap switches** (Class 25,000) are used to start single-phase induction motors up to 5 hp., 550 volts and 2 hp. 110 volts by connecting them directly to the line. They provide overload protection by means of thermal cutouts. These thermal cutouts permit the heavy starting current and short peaks above full load



TYPE WK-10 MOTOR STARTING SWITCH

which do not endanger the motor, but, on continued overloads, open to disconnect the motor from the line.

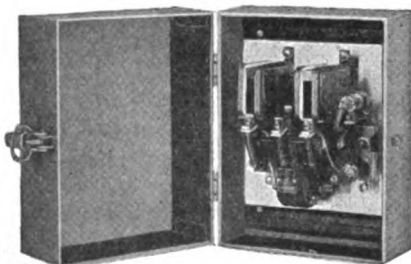
These switches are of the safety type making it impossible for the operator to come in contact with live parts. The switch cannot be operated with the cover open and the cover cannot be opened with the switch in the "run" position.

For larger motors the safety type WK-30 motor starter is used. This is a safety knife switch using thermal cutouts.

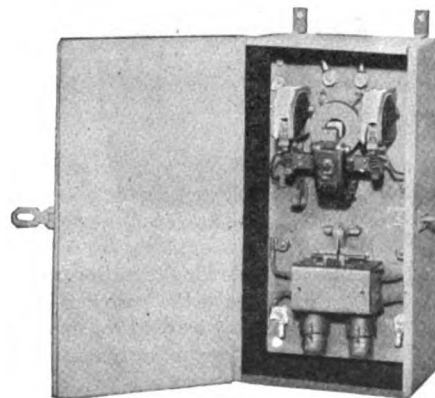
### AUTOMATIC

**Type F across-the-line type automatic starters** are used with single-phase motors from  $\frac{1}{2}$  to 10 hp. for all commercial voltages and frequencies. These starters start the motor by connecting them directly to the line, which applies full line voltage to the motor. Standard motor starters will provide either low-voltage release or protection—both with and without inverse time limit overload protection. These starters are especially desirable

where push-button control is desired or the application is such that a predetermined pressure or liquid level can be automatically obtained by the use of a pressure gauge master or float switch.



TYPE F ACROSS-THE-LINE TYPE AUTOMATIC STARTER WITH THERMAL OVERLOAD RELAY



TYPE F ACROSS-THE-LINE TYPE STARTER WITH INVERSE-TIME-LIMIT OVERLOAD RELAY

# STARTERS FOR SQUIRREL-CAGE MOTORS

## MANUALLY-OPERATED

**WK-10 and WK-20 motor starting snap switches** (Class 25,000) are used to start small squirrel cage induction motors up to 2 hp. 110 volts and 5 hp. 550 volts by connecting them directly to the line. They provide overload protection by means of thermal cutouts. These thermal cutouts permit the



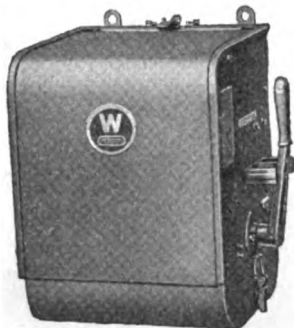
TYPE WK-10 STARTING SWITCH

heavy starting current and short peaks above full load which do not endanger the motor, but on continued overloads opens to disconnect the motor from the line.

These switches are of the safety type making it impossible for the operator to come in contact with live parts. The switch cannot be operated with the cover open and the cover cannot be opened with the switch in the "run" position.

For larger motors the safety type WK-30 motor starter is used. This is a safety knife switch using thermal cutouts.

**Drum reverse switches**, (Class 9630) 1 to 35 hp., are particularly suited for the operation of motors in machine-tool, wood-working and similar services in which reversing is required.



TYPE A AUTO-STARTER

These switches are made for alternating or direct-current circuits. They make the reversing connections to the motor and may be used to connect the motor directly across the line, or in connection with the manual or automatic starter.

**Type A auto-starters** (Class 8160) are used for starting squirrel-cage motors from 5 to 200 hp. by connecting them first to reduced voltage and then

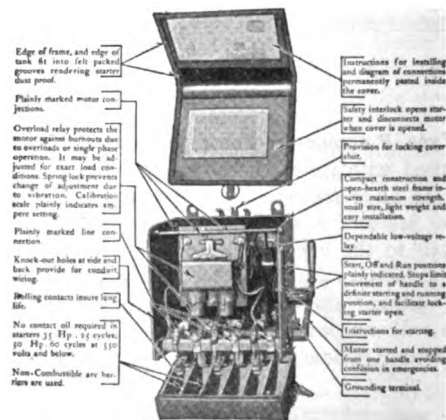
to the line. They are self-contained and consist of a switching mechanism, auto transformer, low-voltage protective device and overload relay—all mounted in a dust-proof, steel enclosing case.

The auto transformers are provided with two taps, giving 65 and 80 per cent of the line voltage for



TYPE 810 DRUM REVERSE SWITCH

starting; the 80 per cent tap is regularly connected when starters are shipped. The starter handle has three positions—start, off, and run, each position plainly marked on the starter case. The handle will remain in the off and the run positions, but will not remain in the start position unless held, returning promptly to the off position if released. This eliminates any possibility of the motor operating on a low-voltage tap should the operator fail to move the handle from the start to the run position. The



TYPE A AUTO-STARTER  
OPEN VIEW

handle cannot be moved from the off to the run position without first going through the start position.

They are designed for both two and three-phase circuits and for all commercial voltages and frequencies. Provision is made for both open and conduit wiring, and they represent a complete safety-first unit in every respect.

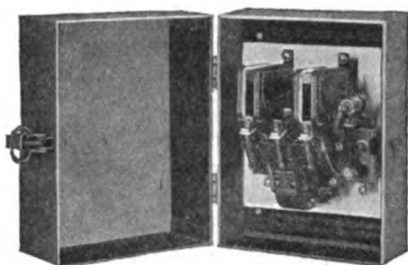
## STARTERS FOR SQUIRREL-CAGE MOTORS—Continued

## AUTOMATIC

**Type F automatic starters for squirrel-cage motors** are used in practically all industrial applications where push button control, automatic starting and acceleration, or automatic control from a float switch or pressure gauge is desired. They safeguard both operator and machine against improper starting or acceleration.

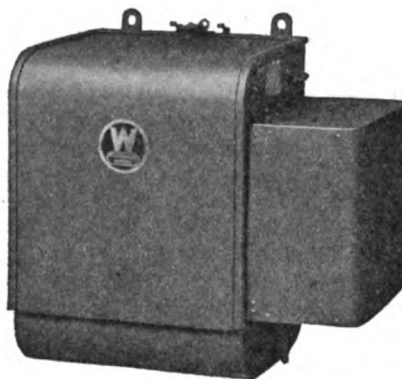
down from any cause, unless the master switch is again operated by the attendant. This arrangement is desirable for starters when used in connection with wood-working machines, machine tools and similar applications, where the operator and the machine or work may be damaged by the unexpected starting of the motor.

**Type F across-the-line type starters** (Class 8210 and 8220) 1 to 25 hp., 2 and 3-phase, for all commer-



TYPE F ACROSS-THE-LINE TYPE STARTER WITH OVERLOAD PROTECTION BY THERMAL RELAYS 10 HP. MAXIMUM

Reliability, durability and simplicity are the features of these starters. There are few parts, which are rugged in construction and easily accessible. All connections are made by magnetic contactors, which are positive in action. The starters may be operated from a remote point by a push button or other type of master switch and proper connections are made automatically in the proper sequence. These starters may be used for either low-voltage release or low-voltage protection service. Starters arranged for low-voltage release operation will automatically



TYPE AF AUTOMATIC AUTO-STARTER

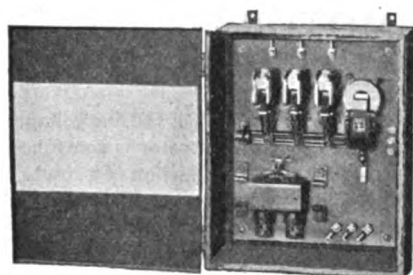
restart the motor upon return of power without the supervision of the operator after the motor stops, due to the failure of power. This arrangement is desirable for such services as pumps, fans and blowers, and, by the addition of float switch or pressure gauge, they will automatically maintain a predetermined liquid level or pressure. Starters arranged for low-voltage protection will not restart the motor upon the return of power after a shut

cial voltages and frequencies, are used for starting squirrel-cage induction motors by connecting them directly to the line. They are provided with overload relay of either the thermal or coil type. This type of starter provides a convenient and inexpensive means for starting small motors, where conditions permit the connecting of the motor directly to the line without transformer, resistance or other means for reducing the voltage.

**The type AF automatic auto-starter** (Class 8295) is a starter of the auto transformer type for motors of 5 to 200 hp., all commercial voltages and frequencies. Its design is very similar to that of the hand operated type A auto starter, except that the switching mechanism is operated automatically by magnet coils mounted on the side of the case. The starter is designed for wall mounting, and is extremely compact and as rugged as the type A, with the additional advantages of remote control and better protection to both the operator and the motor.

The starter may be operated by push button, or any other standard form of master switch and is suitable for either low-voltage release or low-voltage protection applications. The operation is entirely automatic, acceleration being obtained by a definite time limit relay which may be adjusted for any starting time up to fifteen seconds. Overload protection is provided in the running position only, so that close calibration may be obtained.

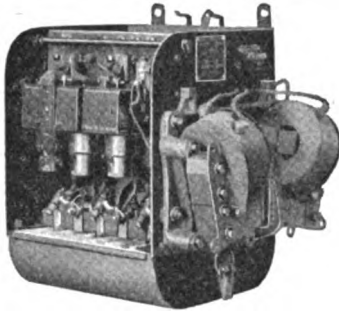
**Type F form A transformer-type starters** (Class 8280 and Class 8300) 5 to 400 hp., 2 and 3 phase, for all commercial voltages and frequencies are



TYPE F ACROSS-THE-LINE TYPE STARTER 25 HP. MAXIMUM

restart the motor upon return of power without the supervision of the operator after the motor stops, due to the failure of power. This arrangement is desirable for such services as pumps, fans and blowers, and, by the addition of float switch or pressure gauge, they will automatically maintain a predetermined liquid level or pressure. Starters arranged for low-voltage protection will not restart the motor upon the return of power after a shut

## STARTERS FOR SQUIRREL-CAGE MOTORS—Continued



TYPE AF AUTOMATIC AUTO-STARTER WITH COVERS REMOVED

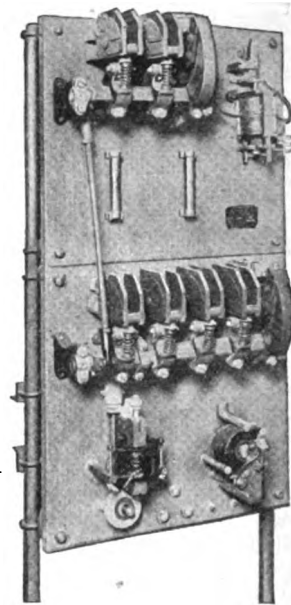
used for starting squirrel-cage induction motors driving pumps, blowers, compressors, line shafting, machine tools and practically all industrial applications where automatic control is desired. These starters start the motor by furnishing reduced voltage by means of auto transformers at the motor terminals during the starting period. Starters for motors above 200 hp., 440 and 550 volts, and above 100 hp., 220 volts use current limit acceleration, while the smaller sizes use definite time limit acceleration. This method reduces the current taken from the line, and the resultant line surges during the starting period. They provide approximately eighty per cent of full load starting torque, which renders them suitable for all applications where a squirrel-cage motor is applicable.

Starters for 200 hp. and above, 550 volts and below consist of a slate panel arranged for floor mounting, having mounted thereon a two-pole line magnetic contactor and a four-pole magnetic contactor for connecting the auto transformer to the line and the motor to the transformer taps, and an inverse time

limit overload relay, which provides protection to the motor against burnouts, due to phase failure or overload. The auto transformer is mounted directly on the rear of the panel.

The smaller size starters are enclosed in a cabinet and are arranged for wall mounting. They have three double-pole contactors of the new type, and are entirely self contained.

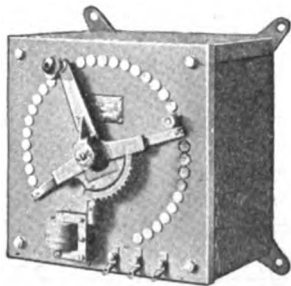
Starters for 2200 volts are similar to the lower voltage starters, with the exception that the magnetic contactors are immersed in oil.



TYPE F TRANSFORMER-TYPE STARTER FOR LARGE MOTOR

## STARTERS AND CONTROLLERS FOR WOUND ROTOR MOTORS MANUALLY-OPERATED

Type F magnetic primary panels (Class 8525) will be found very useful in connection with drum controllers to furnish overload and low-voltage pro-



TYPE PF SPEED CONTROL RHEOSTAT

tection, as well acting as a disconnecting switch for the motor. Primary panels consist of a 3-pole contactor and 2 coil overload relay mounted in a cabinet

as shown by the photograph of the line voltage starter on page 1255. This contactor is controlled by a push button, and, by the addition of a reset contact on the controller, will protect the motor from being started unless all resistance is in circuit.

Type PF starting rheostats, secondary only (Class 8520), 1 to 50 hp., for all commercial voltages and frequencies are used for starting wound-rotor induction motors for non-reversing applications where a face-plate type of starter is desirable. They are characterized by rugged and fire-proof construction and have been approved by the National Board of Fire Underwriters. The copper segments, which are practically the only wearing parts, are accessible and can be readily renewed.

These rheostats are not provided with any primary contacts and limit the starting current of the motor by inserting resistance in the motor secondary. They must be used in connection with

## STARTERS AND CONTROLLERS FOR WOUND-ROTOR MOTORS—Continued

a magnetic primary panel, circuit-breaker or knife switch to control the motor primary. The starting resistor is Class 35 and is mounted at the rear of the face-plate, making a complete secondary control unit.

All rheostats can be provided with enclosing covers to protect the face-plate and the contacts from flying chips and other foreign material and the operator from accidental contact with live parts. Low-voltage protection can be furnished on all sizes, but care should be taken when low-voltage protection is furnished on the secondary controller that the primary switch also includes this feature, or otherwise the motor will be started with all resistance in circuit upon the return of voltage, and if left in this position for an appreciable length of time, the starting resistance will be burned out.



TYPE RF—  
DRUM CONTROLLER  
SECONDARY ONLY

**RF controllers** (Class 8570) are used for starting and regulating the speed of wound rotor induction motors and are suited to all non-reversing applications where a drum type controller is desirable. They are simple in construction, reliable in operation, and all wearing parts can be quickly and easily repaired. The stationary and the moving contacts are heavy copper pieces. The fingers are pressed against the drum contacts by adjustable springs which are protected from the current by copper shunts. These controllers regulate the secondary connections only and do not open the primary circuit. They must have a separate primary magnetic contactor, circuit-breaker or knife switch to control the motor primary. Also starting or speed-regulating resistors must be added to make a complete control unit. These controllers start and control the speed of the motor by cutting out resistance connected in the motor secondary and may be used with either two or three-phase motors providing the motor has a three-phase secondary winding. They are provided with a horizontal handle and the various speed points are indicated on the face of the top casting.

A reset contact is provided in the off position for operating in the control circuit of a primary

contactor to insure starting with all resistance in the motor secondary.

**FA controllers** (Class 8620) are used for starting, reversing and regulating the speed of wound rotor induction motors and are suitable for all applications where a drum controller is desirable. These controllers regulate both the primary and the secondary circuits, and an extra primary switch is desirable only for furnishing overload and low-voltage protection. Starting or speed regulating resistors must be added to make a complete control unit.

These controllers start and regulate the speed of the motor by cutting out resistance connected in the motor secondary and may be used with either two or three-phase motors providing the motor has a three-phase secondary winding. The off, the forward, the reverse and the various speed points are indicated on the face of the top casting. A latch is provided in the off position which prevents inadvertent starting.

A reset contact may be provided in the off position on several of these controllers. This contact is connected in the control circuit of a primary contactor to interlock the two devices.

**Type S drum-contactor controllers** (Class 7100), are used instead of both the RF and FA controllers in the larger sizes, because of the greater current capacity, and longer life of the rolling contacts. These controllers are built both for reversing and non-reversing service, and are constructed the same as the direct-current controllers described on page 1248, except that the sequence of the contactors is different. A reset contact is provided in the off position for use with a magnetic primary panel. The rolling contacts of the type S controller insure long life because of the quick-make and quick-break action of the cam, and in addition are very easily replaced. The contacts are interchangeable with those on magnetic contactors, type AF automatic auto-starters, and type A auto-starters.

**Resistors** (Class 9010) used with these controllers may be either of the grid or the tubular type, or a combination of grids and tubes, depending on the size and the characteristics of the motor. The three-point suspension iron grids are strong and durable and will withstand very heavy overloads for short periods of time without injury.

Complete description of these controllers will be furnished upon request.



WITH COVER IN PLACE

WITH COVER REMOVED

TYPE FA 50-AMPERE REVERSING CONTROLLER

## STARTERS FOR WOUND-ROTOR INDUCTION MOTORS

### AUTOMATIC

**Type F automatic starters for wound-rotor induction motors** are used in practically all industrial applications where push button control, automatic starting or acceleration or automatic control from a float switch or pressure gauge is desired. They safeguard both operator and machine against improper starting or acceleration.

Reliability, durability and simplicity are the features of these starters. There are few parts, which are rugged in construction and easily accessible. All connections are made by magnetic contactors, which are positive in action. The starters may be operated from a remote point by a push button or other type of master switch and proper connections are made automatically in the proper sequence. These starters may be used for either low-voltage release or low-voltage protection service. Starters arranged for low-voltage release operation will automatically restart the motor upon return of power without the supervision of the operator after the motor stops, due to the failure of power. This arrangement is desirable for such services as pumps, fans and blowers, and, by the addition of float switch or pressure gauge, they will automatically maintain a predetermined liquid level or pressure. Starters arranged for low-voltage protection will not restart the motor upon the return of power after a shut down from any cause, unless the master switch is again operated by the attendant. This arrangement is desirable for starters when used in connection with hoists, turntables, cranes, and similar applications, where the operator, or apparatus may be damaged by the unexpected starting of the motor.

Standard automatic starters can be furnished with or without enclosing covers.

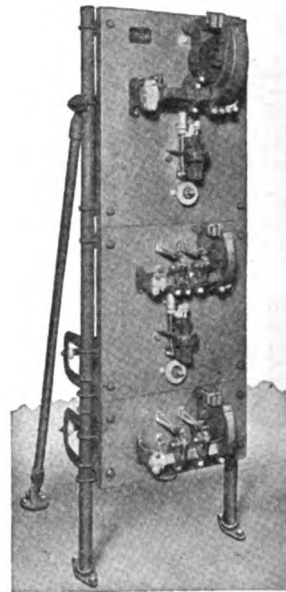
**Type F form B starters (non-reversing)** 5 to 200 hp., 2 and 3-phase, all commercial voltages and frequencies are used for starting wound rotor induction motors in all industrial applications where the advantages of remote control, and automatic starting and stopping are desired, and a wound rotor motor is employed.

They reduce the starting current by inserting resistance in the motor secondary and automatically short-circuiting this resistance by magnetic contactors as the motor attains speed. The accelerating relays provide automatic acceleration at the proper rate every time the motor is started.

These starters are furnished with or without overload protection and are designed, in general, for two classes of service, full load and 50 per cent full load torque—the main difference in the two being that the former requires one more accelerating point, more resistance, and a slightly different accelerating relay setting.

Full load starting torque starters should be used on such applications as plunger pumps, positive pressure blowers, compressors starting with valves open, ore sieves, long line shafts and loads with heavy inertia. These services, in the majority of cases, require wound rotor motors and from 75 to 200 per cent of full load torque to start.

Fifty per cent full load starting torque starters are used on motors driving machine tools, fans,



TYPE F FORM B NON-REVERSING AUTOMATIC STARTER

blowers (except positive pressure), centrifugal pumps starting with valves closed and compressors shunted through a by-pass and similar applications requiring a starting torque of 50 per cent of full load or less.

Starters for 550 volts and below consist of a slate panel, on which is mounted a two-pole, magnetic line contactor for connecting and disconnecting the motor primary, the necessary number of magnetic contactors for progressively short-circuiting resistance in the motor secondary and accelerating relays for controlling the time of closing of these contactors. Starters for motors approximately 50 hp., and below, normally have a resistor mounted directly in back of the panel, while on the larger sizes it is arranged for separate mounting.

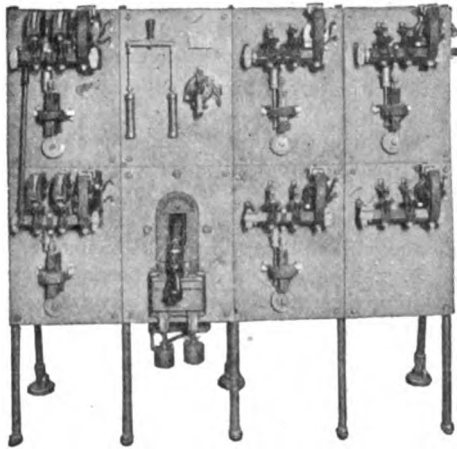
Starters for 2200-volt motors are similar to those for lower voltages, with the exception that the two-pole primary contactor is replaced by a three-pole oil-immersed contactor.

M-157A



## STARTERS FOR WOUND-ROTOR INDUCTION MOTORS—Continued

**Type F Form D Controllers—Reversing** (Class 8950), 10 to 750 hp., 2 and 3-phase, all commercial voltages and frequencies, are used for starting, reversing and speed control of wound rotor induction motors driving cranes, hoists, lift bridges and



TYPE F FORM D REVERSING CONTROLLER

kindred applications where automatic control is desired. These controllers are very similar to the type F form B, described above, except that reversing and speed control are obtained.

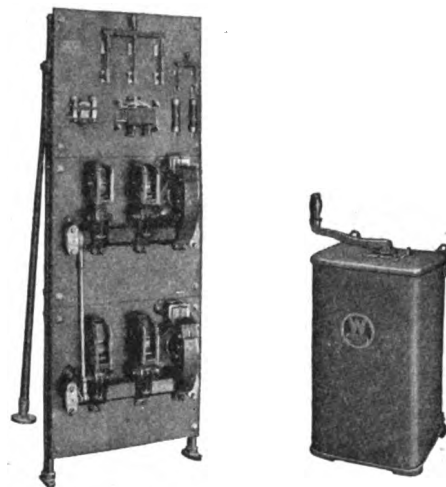
**Type F form D semi-magnetic controllers** are used for starting, stopping, reversing and controlling the speed of wound rotor induction motors. They are used on small hoists, bridges, cranes, dredges and similar applications where the conditions do not warrant a full magnetic controller and where overtravel, overload and low voltage protection are desired. Also where the primary voltage or current is too high to be successfully handled by a drum controller.

The selection of the proper type of controller depends upon the application, size of motor, frequency of service, proficiency of the operator and consideration of initial cost. Drum controllers as listed in class 8620, can sometimes be used as low priced equipments for motors as large as 150 hp. where competent operators are employed, service is infrequent and other means are employed to protect against overtravel, overloads and failure of voltage. However, the majority of applications,

75 hp. and above should be equipped with magnetic controllers and due to their many advantages, it is often desirable to furnish magnetic controllers below this value.

**Overload protection** is provided on equipments 550 volts and below by a two coil double break inverse time limit overload relay. The 2200 volt controllers include a type F circuit breaker which provides this feature.

The primary contacts of the drum contactor controller handle only the control circuit current and establish the direction of travel through the magnetic contactors. The secondary contacts are used to vary the motor speed by changing the resistance connected in the motor secondary. A reset contact is furnished in the off position of the drum controller which is connected in the low voltage relay circuit and prevents the motor from restarting upon the return of power after a shut down due to overload or voltage failure unless the master switch is first returned to the off position.



TYPE F, FORM D, SEMI-MAGNETIC CONTROLLER COMPLETE, CONSISTING OF MAGNETIC PRIMARY REVERSING PANEL AND TYPE S COMBINED PRIMARY MASTER CONTACTORS AND SECONDARY SPEED CONTROL CONTACTORS

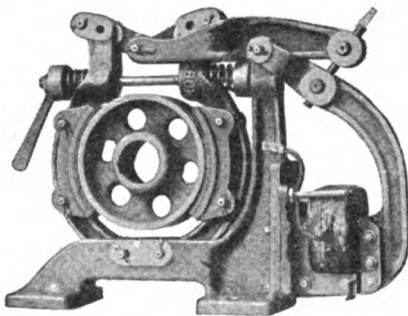
### Auxiliaries

Push buttons, float switches, pressure gauges, reverse switches and other accessories are described under Automatic Control Auxiliaries, page 1251.

## MAGNET-OPERATED BRAKES

### ALTERNATING AND DIRECT-CURRENT—FLOOR AND MOTOR MOUNTING

Magnet-operated brakes are used for stopping motors quickly without jar or shock and for holding their connected loads. They are designed primarily for use with mill, crane and hoist motors where frequent stops and reversals are made and are arranged for separate mounting.

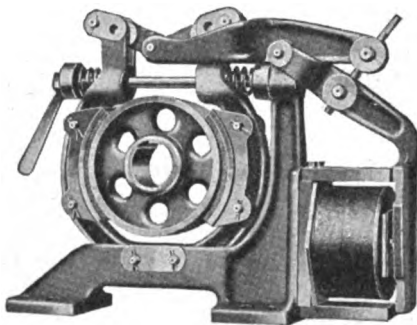


TYPE A ALTERNATING-CURRENT BRAKE

The brakes are simple, rugged and accessible, each consisting essentially of a clapper-type magnet, strong compression springs, series of levers, brake shoes, brake wheel and supporting frame.

The following are a few of the many important features incorporated in these brakes:

1. They are applicable to any horizontal motor within their range and can be arranged for floor, wall or ceiling mounting, and with the magnet on either the right or the left side of motor.



TYPE B DIRECT-CURRENT BRAKE

2. The use of the clapper-type magnet eliminates all moving parts within the coil and the consequent wear, sticking or damage of insulation.

3. The armature is the only moving part of the magnet.

4. The simplicity and accessibility of the few parts render these brakes easy to install, operate and maintain.

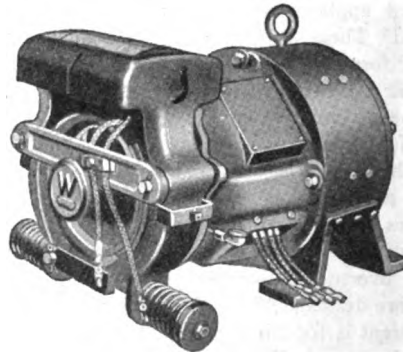
5. The shoes are accessible and can be removed easily and without disturbing brake mounting.

6. Smooth retardation and dependable operation is insured by strong compression springs.

7. Equal clearance between both shoes and brake wheel when brake is released.

8. Self-aligning brake shoes.

9. No danger of load slipping due to brake not operating as brake sets if adjustment for shoe wear is neglected.



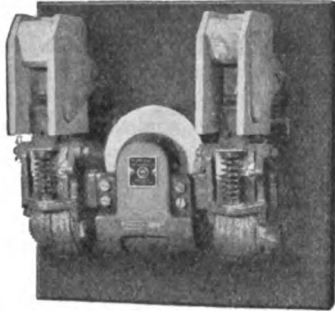
TYPE HB DIRECT-CURRENT BRAKE MOUNTED  
ON TYPE HK MOTOR

**Type A Alternating-Current—Floor Mounting** (Class 9220)—are used with motors 400 hp. and below for 110, 220, 440 and 550 volts for all commercial frequencies.

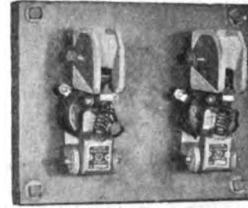
**Type B Direct-Current—Floor Mounting** (Class 9120)—are used with motors 400 hp. and below for 115, 230 and 550 volts.

**Type HB Direct-Current—Motor Mounting**—are used with motors 35 hp. and below for 115, 230 and 550 volts and are arranged for mounting directly on the motor bracket.

## A-C. AND D-C. MAGNETIC CONTACTORS



OPEN TYPE—500 AMPERE—72-C CONTACTOR



OPEN TYPE—75 AMPERE—2X30-C CONTACTORS

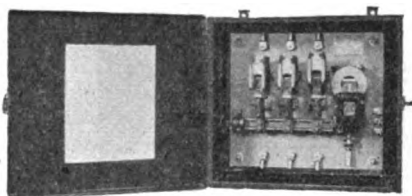
**Magnetic contactors** (class 9610a and 9615) may be used wherever a remotely controlled switch or contactor is desired. They are used as relays, or for controlling power lines supplying one or more motors, and are desirable in practically any application where a circuit carrying current is to be opened and closed frequently. The type F alternating current contactors are also used to start small squirrel cage induction motors by connecting them directly to the line. They are suitable for operation by any form of standard master switch, such as push button, float switch, or pressure gauge. These contactors are designed to withstand the severe service encountered in industrial applications, and are rated on a continuous carrying capacity basis, but will carry 25% overload for one hour without over-heating, and will rupture four times rated current.

The type C direct-current contactors are furnished both single and double pole and the type F alternating-current contactors are furnished both two and

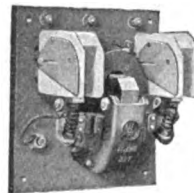
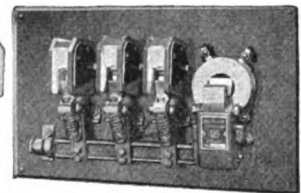
Westinghouse rolling contacts which give long life and eliminate any danger of the contacts welding. They are provided with magnetic blowouts with arc splitters which cause a quick rupture of the arc with minimum flash when the contactor opens under load, resulting in long contact life. The armatures of type F contactors are of the floating type, insuring long life and quiet operation. The shunt coils are designed for continuous duty, and will operate between 85% and 110% of rated voltage. Contacts, springs, shunts and magnetic blowouts are identical and easily interchangeable with like parts on other a-c. (type F) or d-c. (type C) contactors of the same ampere capacity.

**Low-voltage release** is obtained with all contactors with two wire control. This method of control is satisfactory in application where it is safe for power to return suddenly after a failure.

**Low-voltage protection** is required in any application where it would be dangerous for power to be



ENCLOSED TYPE—3 POLE—125 AMPERE—45-F CONTACTOR

OPEN TYPE—TWO-POLE  
75 AMPERE—32-F CONTACTOROPEN TYPE—THREE POLE  
75 AMPERE—35-F CONTACTOR

three pole. They are supplied either open or enclosed and may be applied for either low-voltage release or protection, depending upon the type of master control used.

**Construction.**—These contactors are mounted on a slate panel, which may be provided with feet for wall mounting. The enclosed type contactor is mounted in a sheet metal case, which prevents the entrance of dust, and eliminates accidental contact with live parts. All contactors use standard

returned suddenly after a shut-down. An electrical interlock is provided on all contactors and three wire control with a two point, momentary contact, master switch is required. After opening due to a power failure, the contactor cannot close until the start button is pushed.

The contacts have a slight wiping action upon closing, tending to keep the surfaces clean. To insure good contact, the contactor should be opened and closed at least once a day.

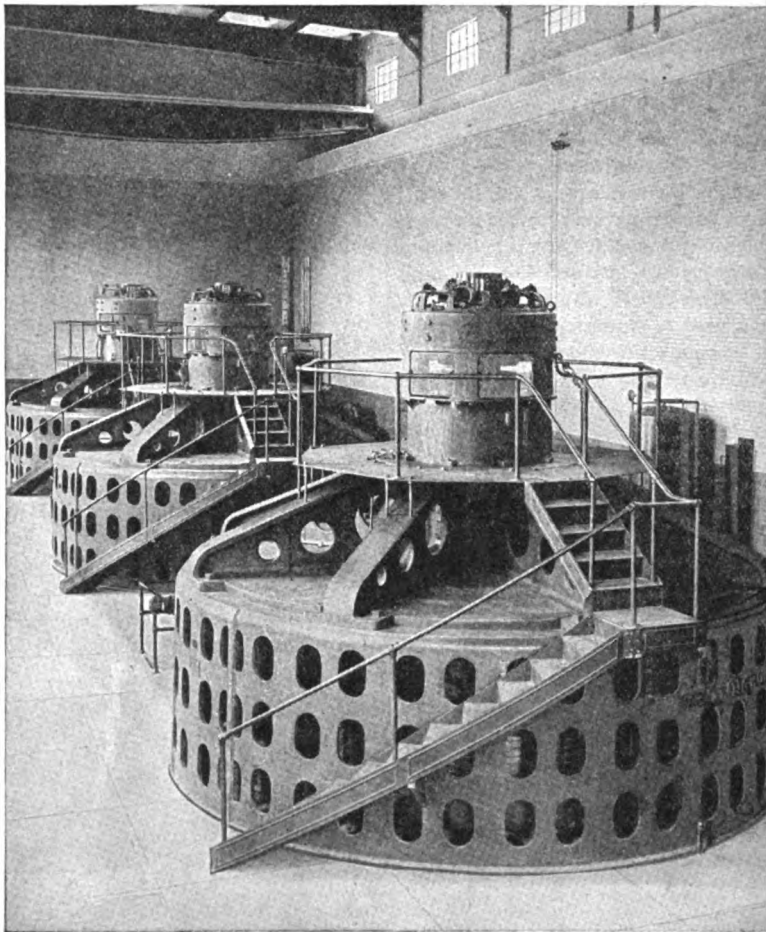
## ALTERNATING-CURRENT GENERATORS

The Westinghouse Company builds a-c. generators for any service condition.

A standard line of small belted units, capacities 17 kilovolt-amperes and upward, permits the selection of the machine best fitted to match in capacity that of the prime mover.

Standard engine type generators are available for direct connection to steam, gas, and oil engines.

Generators for waterwheel drive, in both horizontal and vertical types, are built in sizes as small as 30 kilovolt-amperes and as high as 45,000 kilovolt-amperes, or larger, if required.



THREE 6250 KILOVOLT-AMPERE VERTICAL A-C. GENERATORS—WATERWHEEL DRIVE  
GENERATOR VOLTAGE, 6600—TRANSMISSION VOLTAGE, 140,000

Prices and full particulars, on the machine best suited for your particular conditions, on request.

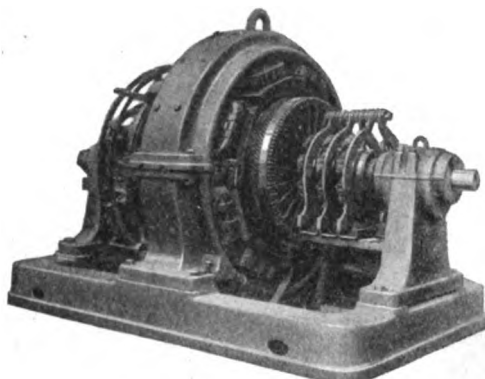
## SYNCHRONOUS CONVERTERS AND SYNCHRONOUS MOTOR-GENERATORS

EFFICIENT

RUGGED

RELIABLE

For All Classes of Service



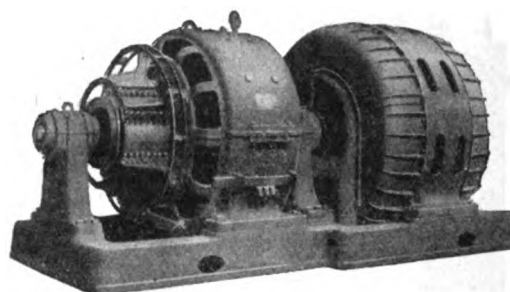
1000-KILOWATT, 60-CYCLE, SYNCHRONOUS CONVERTER

### Synchronous Converters

Kilowatts—100 to 4000  
D-C. Volts—250, 275, 600  
Cycles—25 and 60

**Application**—Westinghouse commutating-pole converters, shunt or compound wound, are applicable to railway and the various kinds of industrial service not requiring minute direct-current voltage adjustment, in which cases the booster converter for larger capacities or an induction regulator with synchronous converter in the small capacities is applicable.

Standard converters can be arranged for either alternating- or direct-current, self-starting, or for both, although alternating-current, self-starting, is usually preferred.



1000-KILOWATT, 60-CYCLE, MOTOR-GENERATOR

### Synchronous Motor-Generators

Kilowatts— $\frac{1}{4}$  to 1500  
D-C. Volts—125, 250, 275, 600  
Cycles—25 and 60

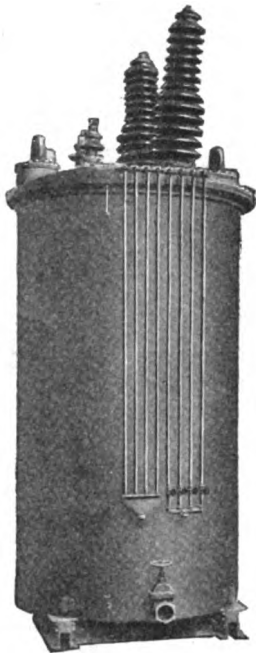
**Application**—Westinghouse synchronous motor-generators are applicable for converting alternating to direct current except where alternating-current line conditions are such that it is inadvisable to use synchronous apparatus, in which cases the induction motor-generator is applicable. The rapid development in the last five years of very economical alternating-current generation and transmission apparatus makes a careful study of conditions and types of converting apparatus imperative, if the same relative efficiency is to be maintained.

## LARGE POWER TRANSFORMERS

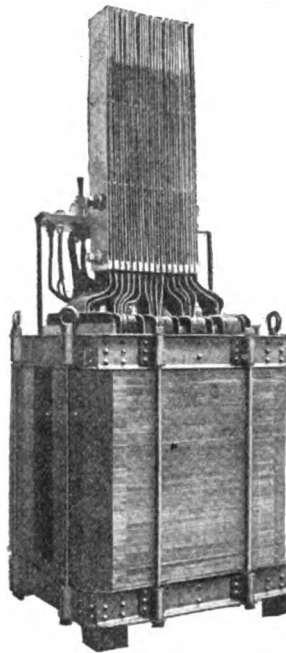
Transformers, making possible the use of distant sources of power by stepping up the voltage at the source and stepping it down where wanted, are supplied by this company in any size, any voltage, either single or three-phase, to meet any specific

Mechanical Strength, as these factors mean Reliability and Ability to meet operating conditions.

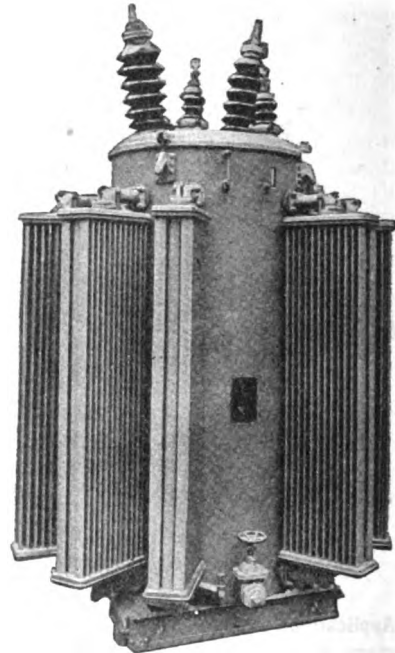
The successful operation of a power transformer depends on a number of factors, chief of which is the correctness of its design. Westinghouse power



A 14,000 Kv-a. WATER-COOLED TRANSFORMER FOR 150,000-VOLT SERVICE, SINGLE PHASE, 60 CYCLES



THE CORE AND COILS OF A LARGE TRANSFORMER USED FOR SUPPLYING 36,000 AMPERES FOR AN ELECTRIC FURNACE IN MAKING CALCIUM CARBIDE



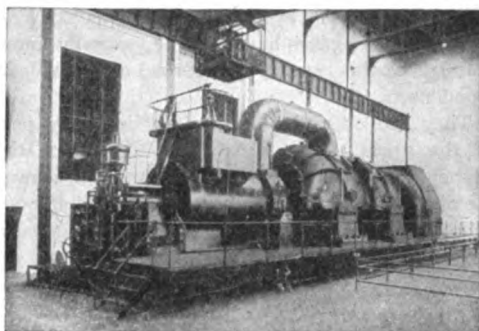
A SELF-COOLING TRANSFORMER OF 2,000 Kv-a. CAPACITY, 66,000 VOLTS

requirements. Three general types are recognized, the classification being made on the way in which the heat resulting from their electrical losses is removed—Self Cooled, Water Cooled and Air Blast.

On all large high voltage transformers the greatest attention is paid to Insulation, Ventilation and

transformers embody fundamentally correct principles of design which have been arrived at through painstaking study during many years of successful transformer manufacture. In Westinghouse transformer construction the factors are carefully balanced which guarantee long life, efficient performance, and security against breakdown.

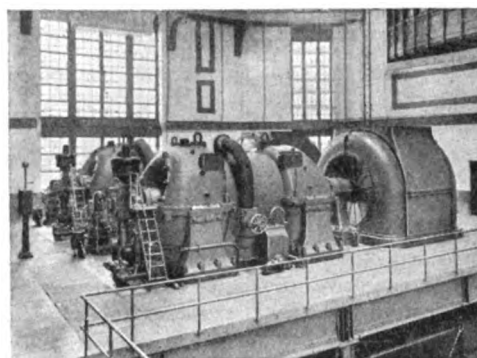
## LARGE STEAM TURBINE-GENERATOR UNITS



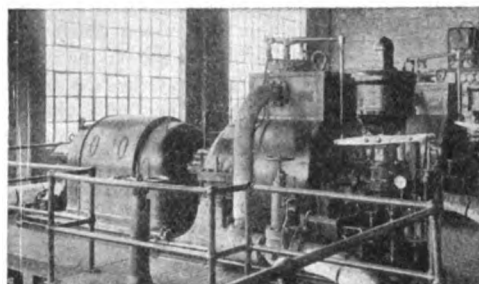
35,000 KILOWATT UNIT

Units in which the complete expansion of the steam is carried out in a single cylinder are built in capacities up to 30,000 kilowatts. To obtain the most reliable machine possible, units from 30,000 kilowatts to 70,000 kilowatts are built in two or more cylinders. The excellent performance of Westinghouse Steam Turbines shows the correctness of these designs.

Westinghouse Steam Turbines are of the reaction or Parsons type or a combination of the impulse and reaction principles depending upon the particular problems to be met. **Economy** and **Reliability** are the factors governing the type of construction used.



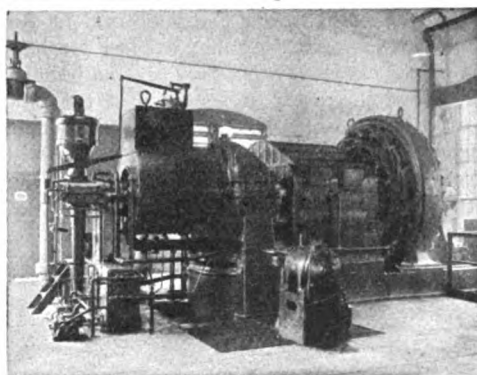
TWO 20,000 KILOWATT UNITS



750 KILOWATT UNIT

Westinghouse Steam Turbines are designed and built for both condensing and non-condensing service, and are also furnished in low pressure or exhaust steam, and mixed pressure types. Where exhaust steam is desired for heating or manufacturing purposes, the bleeder or extraction type turbine is furnished.

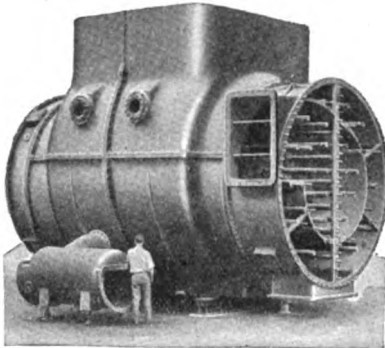
Westinghouse Reduction Gears are of the flexible pinion frame type. By an ingenious construction, the pinion is always kept in perfect alignment with the gear. This, combined with the most accurate workmanship possible, insures **noiseless operation** and **high efficiency**. Westinghouse gears are **unexcelled** for any application of the steam turbine driving slow-speed machinery.



1500 KILOWATT D-C. GEARED UNIT

60-106A

## CONDENSING EQUIPMENT



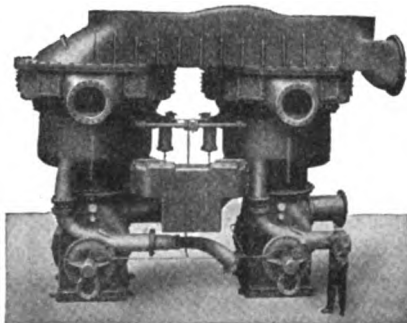
LARGE AND SMALL SURFACE CONDENSERS

### Surface Condensers

Serving turbines up to 100,000 horsepower capacity.

All Westinghouse surface condensers are designed to get the maximum temperature of condensate and a minimum drop in pressure through the condenser tube bank.

The smaller condensers have a very compact arrangement of pumps that permits all to be connected to one drive, eliminates complicated interconnecting piping and utilizes the minimum space.



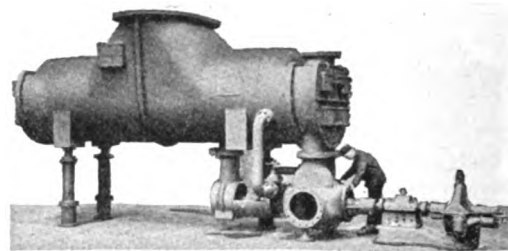
TWIN JET CONDENSER

All these condensers are equipped with the Westinghouse LeBlanc Air Pumps or Steam Jet Air Ejectors, the most efficient air scavenger for high vacua on the market. This pump has the peculiar advantage of increasing in efficiency at the time highest efficiency is most needed, when the Vacuum is **Highest**.

Westinghouse Condensers are unexcelled in ability to maintain a high vacuum, simplicity of construction, reliability and compactness.

Because of their exceptional performance Westinghouse Condensers have become generally known throughout this country and abroad as High Vacua Condensers.

They are operating successfully in many parts of the world, Peru, Russia, Brazil, Porto Rico, Manchuria, Cuba, New Foundland, Japan, Hawaii, Mexico, British West Indies, Alaska, Siberia and other foreign lands. Only condensers of undisputed reliability could have become so widely known and used.

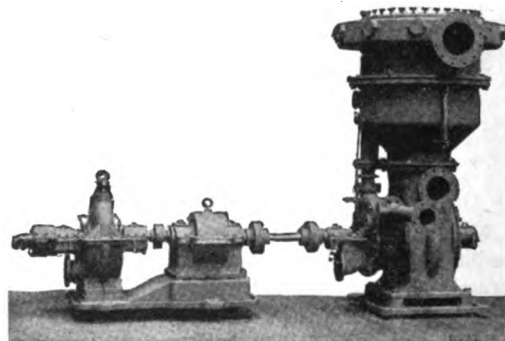


UNIT TYPE SURFACE CONDENSER

### Jet Condensers

Now serving turbines up to 65,000 horsepower capacity.

Jet condensers, either low level, or high level, are desirable for some installations. Large low level jets are frequently built as twin units, not because the limit in size of a single condenser is reached, but because of the greater flexibility and saving in head room. High level jet or barometric condensers can be used when the elevations are such that the cooling water can be allowed to flow away from the condenser head by gravity.

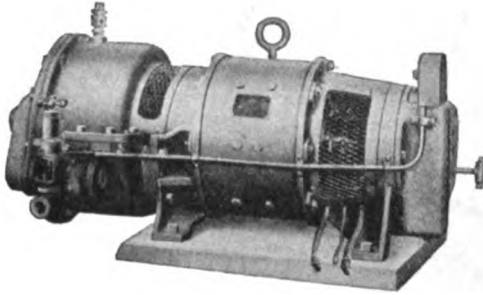


SMALL LOW LEVEL JET CONDENSER



## SMALL TURBINES FOR ALL NEEDS

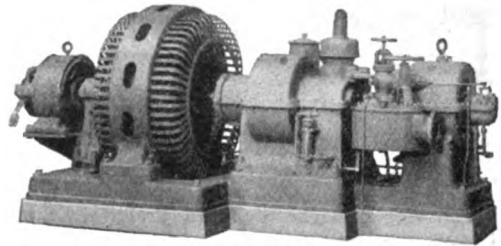
The Westinghouse Electric & Manufacturing Company holds a pre-eminent position in the small turbine field, due to their ability to furnish these machines for all classes of service.



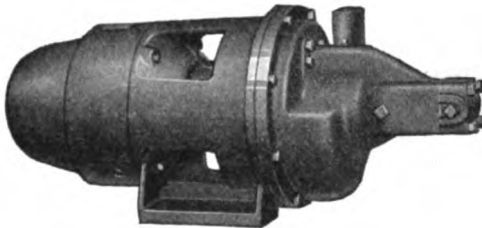
SMALL DIRECT-CURRENT NON-CONDENSING TURBINE-GENERATOR UNIT

Illustrating small direct connected turbine generator units, built in capacities from 5 to 15 kilowatts. A very compact lighting set for boats, dredges, steam shovels, small industrial plants and for furnishing electricity to electric magnets on locomotive cranes.

Built in capacities of 25 to 1000-kilowatts. Very economical. In small sizes used as exciters and as the main unit in large manufacturing plants where exhaust steam is needed for heating purposes.



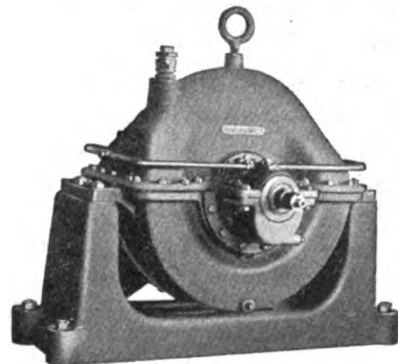
NON-CONDENSING GEARED TURBINE-GENERATOR UNIT FOR HIGH ECONOMY



500-WATT LOCOMOTIVE HEADLIGHTER UNIT

This unit has been developed in sizes  $\frac{1}{2}$  and  $1\frac{1}{2}$  Kilowatts to meet the recommendations of steam railroad engineers. It can be used for lighting service in isolated steam plants (pumping stations), small steam shovels, oil-well derricks and where a small amount of lighting is required. It is designed for severe outdoor service, and is easily portable.

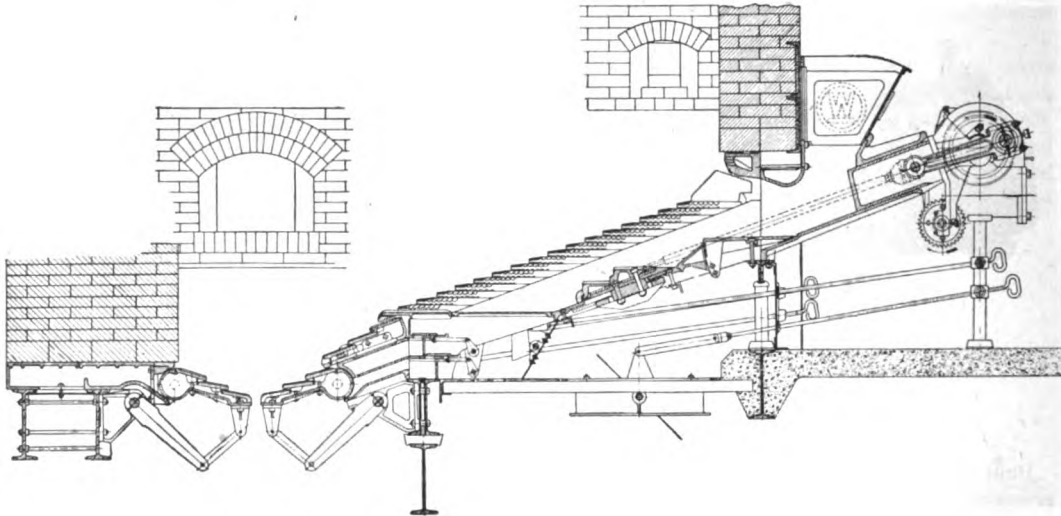
A line of small turbines for driving centrifugal pumps and fans. Can be arranged for either direct connection to driven apparatus or through the medium of a gear.



STEAM TURBINE FOR DRIVING PUMPS AND BLOWERS

## MECHANICAL STOKERS

### UNDERFEED, OVERFEED AND CHAIN GRATE



SECTION THROUGH STANDARD MULTIPLE RETORT UNDERFEED STOKER

**The Westinghouse Standard Underfeed Stoker** is of the multiple retort type. This stoker serves a type of plant which is subjected to peak loads and sudden increases in steam demands. It has a wide range of economical operation using low grade western coal as well as high grade eastern coal.

This stoker is giving high efficiencies at capacities up to 450 per cent of rating on boilers of 300 horse power and up, which is a factor of great importance in central station operation.

**The Westinghouse New Model Roney Stoker** is of the overfeed type and is used extensively in every section of the country. This stoker operates at high efficiency and economy with boilers up to 600 horse power. Below rating to 200 per cent of boiler rating Natural or induced draft with the Roney Stoker gives very satisfactory results.

It is particularly adaptable to fire tube and water tube boilers of the capacity generally found in the moderate sized plant.

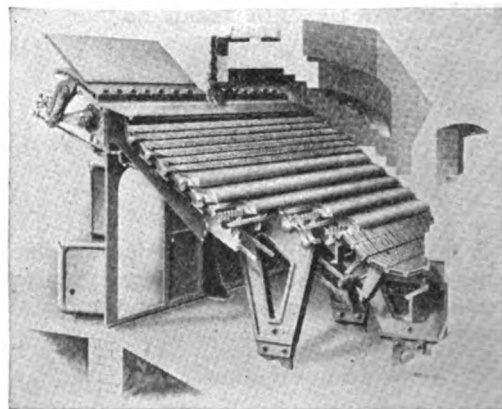
The advantages of the Roney stoker, when applied to moderate size boilers are that: the cost of labor is reduced; fuel is saved; smokeless combustion is secured and the boiler capacity is increased.

**The Westinghouse Chain Grate Stoker** is a type of overfeed stoker.

Positive control of combustion, with flexible operation, is obtained by the Westinghouse Zone System of Air Distribution from forced draft fans.

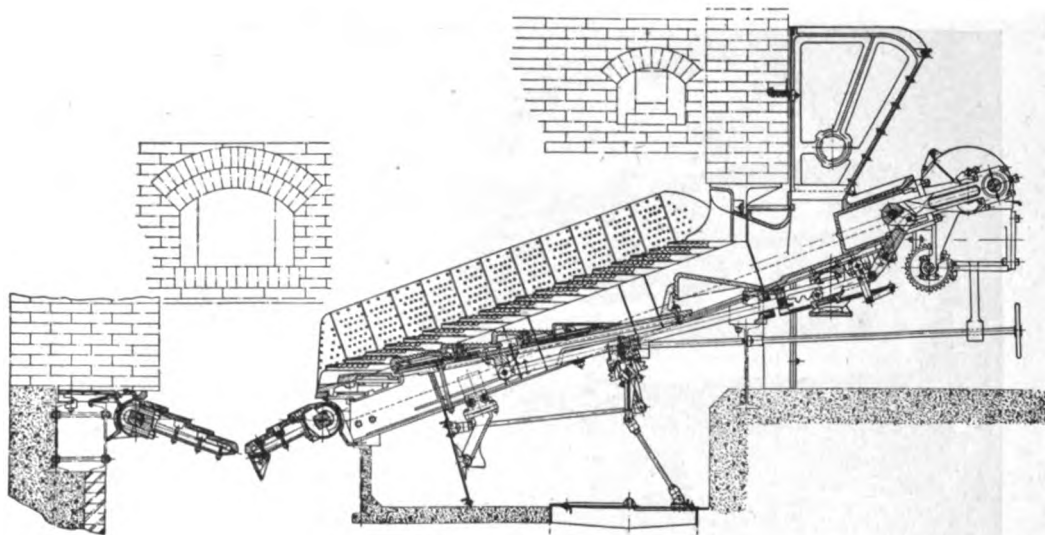
The material and workmanship entering into each piece of a Westinghouse stoker is the result of years of scientific research and practical plant operating development.

Our customers report the "upkeep as surprisingly low" and "much better than guarantee" and the stokers are "entirely satisfactory in every respect."



NEW MODEL RONEY STOKER

## NEW MODEL MULTIPLE RETORT UNDERFEED STOKER



SECTION THROUGH NEW MODEL MULTIPLE RETORT UNDERFEED STOKER

The Westinghouse New Model Multiple Retort Underfeed Stoker is built in sizes applicable to boilers from 250 horse power upward. The design is flexible permitting the use of a wide range of equipment giving maximum efficiencies and capacities with all grades of coal.

**Construction**—Several years were spent in developing this stoker. Considerable attention was given the following items to produce a stoker that has superior merit.

**Air Distributing Box**—This box combines the additional feature of a top locking tuyere with the air distributing box which is a scientific feature applied to Westinghouse stokers. The warmed air is delivered over the top of the fuel bed at the front in the ignition zone of the stoker. It combines with the volatile gas driven off in this zone and assists materially in obtaining a high furnace efficiency which produces a high combustion temperature and facilitates instantaneous ignition of the coal.

**Expanding Fuel Throat**—The air distributing box is placed well under the front wall support and is so designed as to produce a gradually expanding throat. This feature spreads the ignited fuel over the tuyere rows more readily and uniformly than with a longer throat. The space at the top of the tuyere row is covered with fuel. No air can escape in a jet like column with a blow torch action on the front wall. The fuel mass does not cake in the retort.

**Flexible Fuel Distribution**—Coal is fed from a large hopper by large rams and distributed uniformly on the fuel bed by secondary rams located in the retorts. This arrangement gives extreme flexibility in controlling the shape of the fuel bed and regulating combustion conditions.

**Large Wind Box**—The wind box is deep and large and is completely controlled by two dampers.

**Extension Sidewall Tuyeres**—These cast iron air cooled tuyeres are furnished as standard equipment with this stoker. They prevent the formation of clinkers on the sidewalls below the fire line and materially aid combustion without diluting the furnace gases.

**Retort Tuyeres**—Westinghouse retort tuyeres admit air at the lower end of the retorts. This air passes up through the masses of hot coke which is broken up by the secondary rams. Due to this fact a high rate of combustion is constantly maintained at this point.

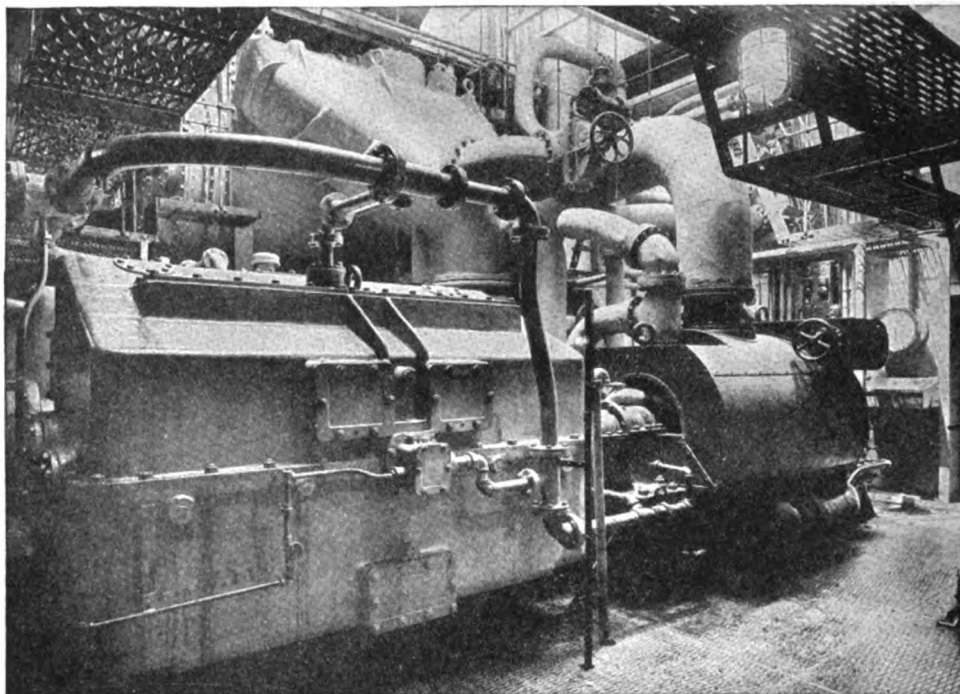
**Agitator and Dump Grates**—The front dump grate is an agitator which provides a positive means for shaking up the mass of refuse as it is pushed down from the overfeed section on to the dump grate, thus permitting the combustible matter remaining in the refuse to be completely burned out. This accounts for the combustible in the refuse from this stoker being very low.

**Clinker Grinders**—These positive ash discharge devices are built to apply at the end of the agitating element.

**Steam Dumping Equipment**—It consists of two cylinders mounted on the same base side by side. The control valve is self contained and may be located in the most convenient place. One valve handle controls both the up and down motion of one dump grate.

**Operating Advantages**—(1) Uniform distribution of fuel, (2) Uniform distribution of air, (3) Agitation of coked fuel masses.

## GEARED-TURBINE DRIVE FOR SHIPS



ENGINE ROOM, 3000 S.H.P. PROPELLING UNIT

The mechanical or geared-turbine drive is most applicable on the merchant or passenger ship operating most of the time at a given speed.

This type of drive allows the efficient high-speed turbine to be connected to the propeller with its best efficiency at low speed, the geared reduction allowing the least transmission loss of any type of apparatus, with the result that the highest overall efficiency is obtained.

This is most important in a commercial vessel, since the saving in fuel consumption is from 18 to 30 per cent better than the reciprocating engine drive. In addition, the space requirements and cost of upkeep are less.

The mechanical drive consists primarily of a combination impulse-reaction Westinghouse turbine, usually of the cross-compound or complete expansion type, transmitting power to the propeller shaft through a two-pinion or single-pinion double reduction gear, reducing from a turbine speed of

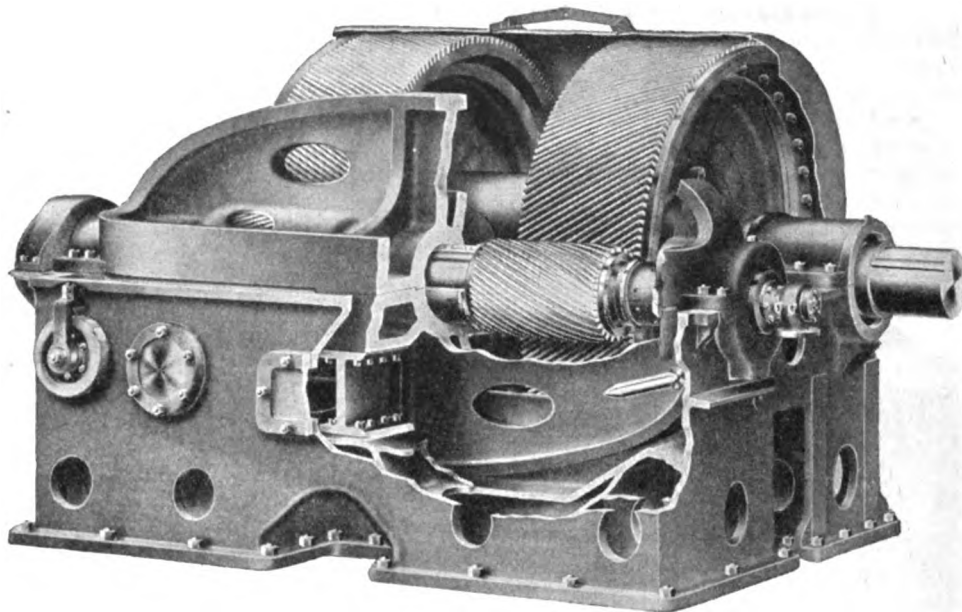
about 3600 r.p.m. to a propeller speed of around 90 r.p.m.

The turbine is fitted with reversing impulse element in the ahead cylinders, the flow to ahead or astern nozzles being controlled by the maneuvering valve. Besides steam strainers, turbine piping and the usual auxiliary fittings, the turbines are fitted with an overspeed governor and valve apparatus.

The gear is of the flexible-frame type, double reduction, either single or two-pinion, depending upon whether turbine is complete expansion or cross-compound type; in either case the higher speed gearing reducing to and acting upon the low speed gear and shaft connected to the propeller.

In all except the smaller sizes of equipments, the turbines are of the cross-compound or divided flow type, a feature of proved reliability, since in cases where accidents have happened to one high-speed element, the vessel has made port easily, driven by the remaining element with the damaged machine disconnected.

## GEARED-TURBINE DRIVE FOR SHIPS—Continued



SHOWING FLEXIBLE FRAME FEATURE OF  
WESTINGHOUSE REDUCTION GEAR

### Special Features

Special features of Westinghouse geared-turbine drives are:

**Flexible Frame Reduction Gear**—Wherein the flexible frames carry the high and intermediate reduction gearing, eliminating the wear and strain caused by flexure of gear frames with movement of the ship's structure, by permitting this gearing to adjust its alignment automatically with the main gear shaft.

**Automatic Governor**—Instead of the old type throttle valve which required constant attention of an engineer when the propeller was plunging in and out of water during rough weather, the turbines are fitted with an automatic overspeed governor which prevents turbine overspeeding if load is released, but allowing continuous operation of the turbine. In addition to this, a safety stop acting at a higher speed prevents accidents in case of failure of governor apparatus.

**Maneuvering Valves**—The ahead and astern operation of turbine is controlled by means of a single hand wheel, insuring rapid and positive control with a single movement.

### Turbine Types

The principal types of turbines used in Westinghouse marine propulsion, mechanical drive, are as follows:

**The Complete-Expansion Type**—This is used chiefly in small vessels, with powers ranging from 1400 to 2000 S.hp. The expansion takes place in a single cylinder, the gears being of the single-pinion, double-reduction type.

**Cross-Compound Type, 3600 R.P.M.**—This type is used over the range between 2000 and 5000 S.hp., the turbines operating in series, each connected to one of the two pinion shafts.

**Divided-Flow Type, 3600 R.P.M. (5000 to 7000 S.hp.)**—This construction, a modification of the cross-compound principle, with the reaction elements in parallel, allows better efficiency at this power range by permitting the high speed to be maintained with larger capacity turbines.

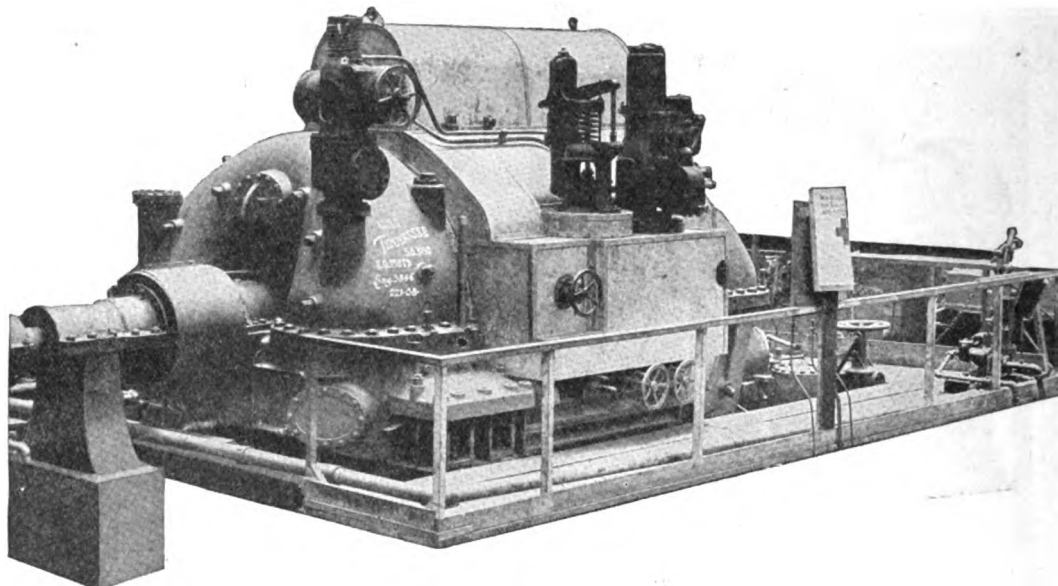
**Cross-Compound Type, 7000 S.hp. Up, 3000 R.P.M.**—The same principle as used in smaller powers, the capacity and size has increased to such extent that the high efficiency may be maintained with the lower speeds.

### CONDENSING EQUIPMENTS

A complete line of surface condensers is also manufactured, with their auxiliaries, to serve marine turbines. This equipment is very similar to that used in land practice except that the air

ejector, a light and very compact piece of apparatus with no moving parts, replaces the usual air pump. The intercooler type ejector can be furnished if desired.

## TURBINE-ELECTRIC DRIVE FOR SHIPS



ONE OF THE MAIN TURBINES OF THE STEAM-ELECTRIC U. S. S. TENNESSEE ON TEST AT THE EAST PITTSBURGH WORKS

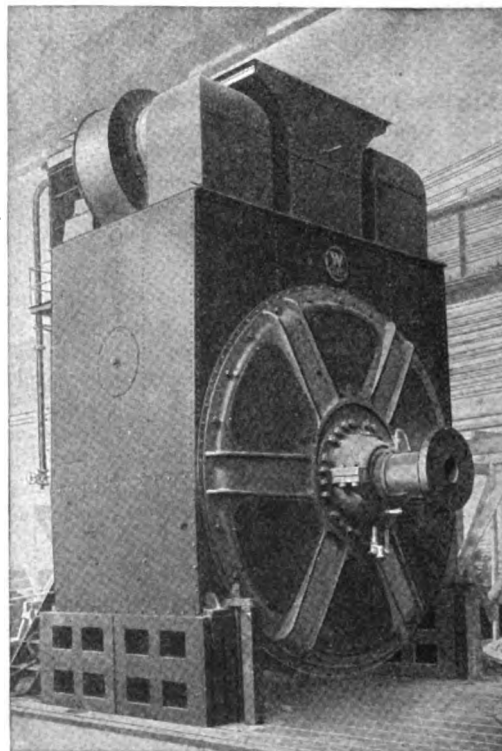
This is of use chiefly where flexibility of control and operation is necessitated by frequent maneuvering or operating at cruising speeds, as at a given steady speed it is not quite so economical as the mechanical drive, while its cost is greater.

It consists primarily of complete expansion turbines, driving direct-connected a-c. generators at high speed, the speed reduction being electrical, the propellers being driven by low speed reversing motors. The induction type motor is used on account of the ease of reversing and control.

By use of the electric drive extreme flexibility of arrangement is possible, since the driving motor may be located entirely independent of the generating unit.

In high powered vessels where such drives find their best application, and where cruising speeds, requiring wide variations of power, are necessary, high operating efficiency may be obtained by operating all motors from one generating unit running at its full load capacity, cutting in other generating units as the load increases.

The arrangement and design of the electric drive varies so greatly with each particular requirement that little definite data can be given for general information. In general it has been found that its best field of use is for naval vessels of the higher classes.



ONE OF THE MAIN DRIVING MOTORS OF THE U. S. S. TENNESSEE

## DIESEL-ELECTRIC MARINE EQUIPMENT

The Diesel Electric Drive consists primarily of Diesel engines, driving direct-connected d-c. generators, (with such exciters as are necessary), and having the generators connected in series and driving the propeller motors. The speed and direction of the motors are controlled by means of the Ward-Leonard System, the operation of reversing rheostats in the generator field giving the desired results.

inspection or repair and the vessel can proceed with little reduction in speed. It is almost impossible to cripple such a vessel in the way the direct driven ship may be if its only engine breaks down.

In addition, the elimination of reversing apparatus and the fact that the engines always rotate in one direction adds to the reliability.

**Flexibility**—The small size of the units involved and the fact that they can be located independently

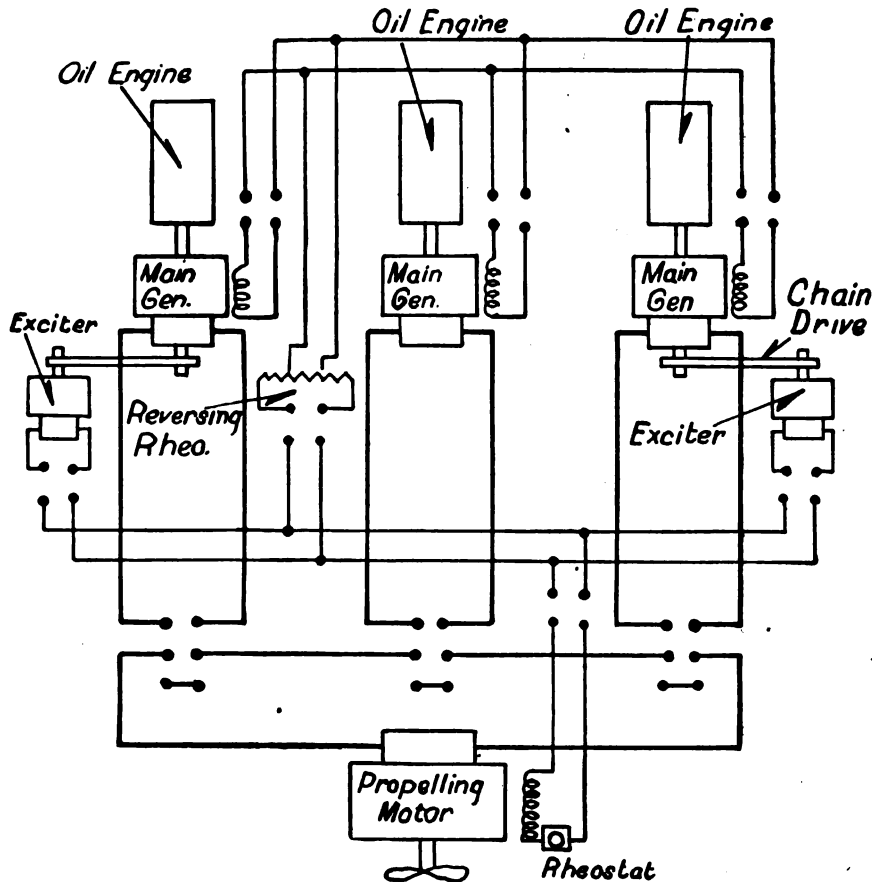


DIAGRAM OF CONNECTIONS—DIESEL-ELECTRIC DRIVE

### Advantages

**Economy**—The Diesel Engine is the most economical form of prime mover known, its fuel consumption being less than half that of the steam turbine. The introduction of the electrical equipment decreases the efficiency to some extent, which decrease is partly balanced by economy due to concentrating power on a single screw, the smaller upkeep and first cost, and cruising economy; and is more than balanced by other advantages listed.

**Reliability**—Electric Drive permits the use of multiple light, high speed units of standard construction. One or more units may be shut down for

of the propeller shaft allows any grouping desired for best engine room arrangement.

They can be designed to produce power for other requirements, an especially desirable feature on dredges and similar vessels where great auxiliary power is necessary.

For cruising or running at reduced speed, some of the generating units may be shut down, the remaining units furnishing power at their full load, and consequently highest efficiency.

In double ended ferries, power can be directed to the stern screw, revolving bow screw just enough to take up slip thus greatly increasing overall efficiency.

## DIESEL-ELECTRIC MARINE EQUIPMENT—Continued

**Ease of Control and Maneuvering**—Controlling the motor speed and rotation by the changing of a small field rheostat is such a simple and light operation that (as it can be carried out independently of main units except for the field cables) it can be placed in the hands of the pilot, who thus has complete control of the vessel from the pilot house. This is invaluable in narrow waters where frequent maneuvering and instant control of screw are essential.

**Field for Diesel-Electric Drive**

The advantages listed show this system of drive is especially applicable where great variations of power required occur, either on account of cruising, running at reduced speed, or operating auxiliary machinery. Vessels coming in this class are ferries, dredges, trawlers, cable laying vessels, coast guard cutters and light cruising vessels, fireboats and river and lake vessels.

It will also be found applicable on high powered

vessels where the economy of the Diesel engine is required, but the power is too great to be generated for direct driving of one or even two screws.

To date, the Westinghouse Company has or is applying this type of power to auxiliary yachts, ferries, river boats and dredges.

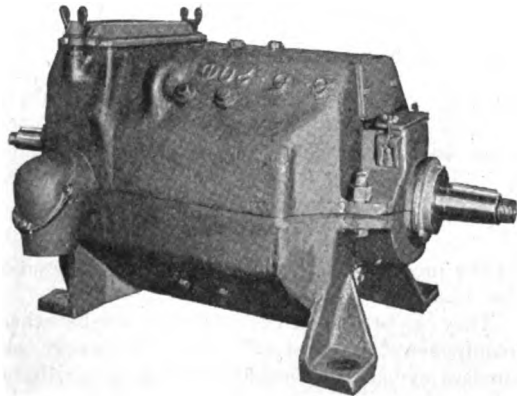
The diagram of connections given shows a typical drive, except that latest practice is to use direct connected exciters. For normal operation at full power the generators are connected in series to the propelling motor, all being arranged for separate excitation. The motor being separately excited at constant value, the speed varies directly with the generator voltage, which is controlled by the reversing rheostat in the generator fields. The movement of the rheostat through any desired number of points gives a large speed range from zero to maximum in either direction. Such control also does not interrupt or require the breaking of any large currents, only the relatively small field currents. Double throw switches enable any generator to be cut out of service.

**SHIPBOARD AUXILIARY ELECTRICAL EQUIPMENT**

Second to the Diesel Engine and its modified systems of propulsion, the electrification of deck and engine room auxiliaries has been the most important step in increasing the economical operation of merchant vessels.

It was known steam deck auxiliaries were extremely wasteful, while condensation loss in long steam lines, leakage and freezing, were accepted as necessities on account of the supposed difficulty of designing electric apparatus which could give proper service after immersion in heavy seas and in the rigorous deck operating conditions.

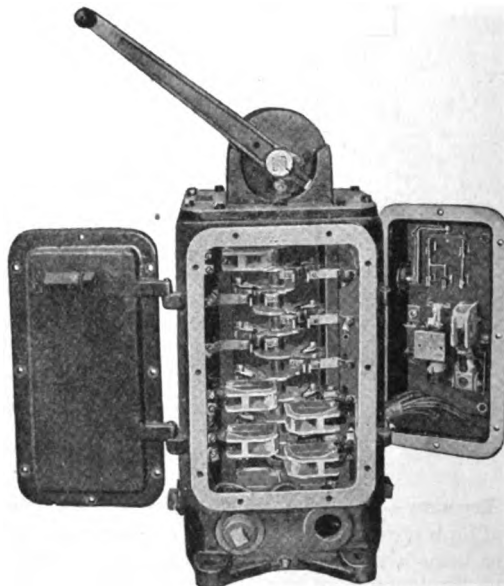
The controllers, of the type S contactor type, are also enclosed in a heavy cast iron housing. Hinged doors allow easy access to the interior, but bolt against heavy rubber gaskets when closed. A vertical control handle, operating in offset slots



40 HP. DIRECT-CURRENT DECK  
WINCH MOTOR

**The MC Motor**

To meet such needs this Company has redesigned the MC line of motors for marine service. Sealing rings and glands around the shaft prevent seepage of water, the conduit box is sealed, as are the hand hole covers opening to bearings and commutator. The whole is given a special marine impregnation and all exposed finished parts are heavily sherardized.



HAND-OPERATED CONTROLLER  
FOR DECK WINCH MOTOR

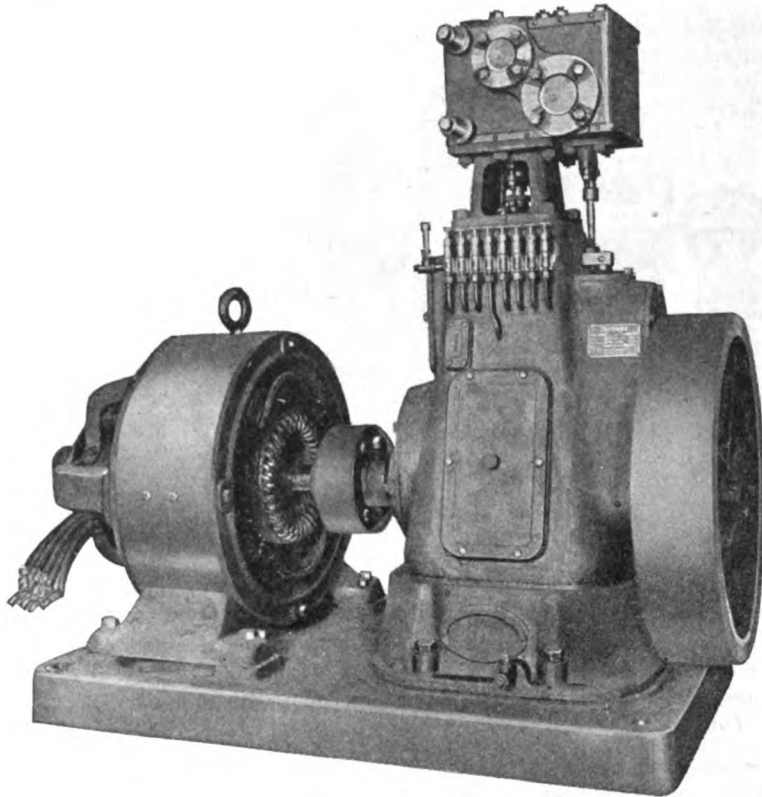
to prevent "plugging" of motor by too rapid throw of lever, gives a movement similar to the steam winch control lever to which the stevedore is accustomed.

The anchor windlass motor is of similar construction, though the control is usually mounted below deck. The steering gear motor, enclosed in a deck house, is usually of the open type SK.

S-105A



## STEAM ENGINE-DRIVEN MARINE SETS



35 Kw. ENGINE-DRIVEN LIGHTING SET

The Westinghouse Company is in a position to supply complete engine-generator sets for lighting and power service, from 5 to 60 Kw. The sets are compact units consisting of the Westinghouse "SK" Marine Generator driven by and mounted on a common base with a vertical single cylinder steam engine.

### The Engine

**Frame**—The frame is made oil and dust proof.

**Cylinder**—The cylinder is of close grained iron, of a special mixture insuring absolutely homogeneous castings, cast in one piece with the valve chest.

**Governor**—The engine is equipped with an inertia governor of the well known Rites type.

**Valve**—The valve is of the piston type and operates in a renewable bushing, which forms the valve parts.

**Piston and Connecting Rod**—The piston is of cast iron, cored for lightness and fitted with cast iron snap packing ring. Both the connecting rod and the piston rod are made of open hearth forged steel, each in a single forging.

**Crank Shaft**—The crank shaft is of open hearth steel, made in a single forging, machined all over and fitted with balancing counter-weights.

**Lubrication**—The lubricating system is automatic, continuous and self-contained, requiring no independent tanks or reservoir.

**Accessories**—The following accessories are regularly furnished: Set of Wrenches, Anchor Bolts and Plates.

### The Generator

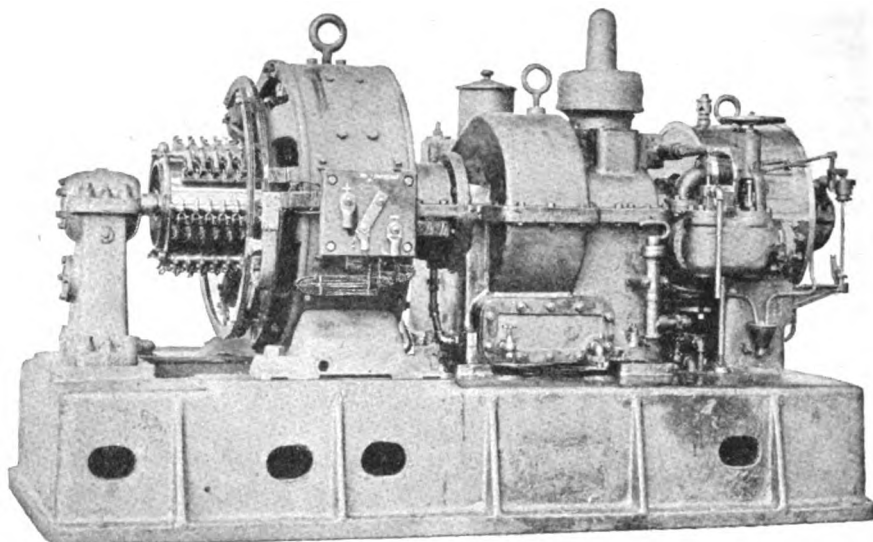
The Westinghouse type SK generators, forming part of these sets, have all the good features that have made the line of SK motors and generators so successful in general utility service and in many special applications.

**Frame**—The frame is forged from open hearth steel. The babbitt-lined, solid steel, shell bearing is ring-oiled and dust-proof.

**Construction**—The construction is open and the generator well ventilated. The armature coils are so made that no cross-overs on edge occur. Sparkless commutation results from the application of commutating poles and the wear of commutator and brushes is reduced to a minimum.

**Marine Service**—Special attention is given the generator during manufacture in order that it may meet the conditions of marine service. The windings are given a special impregnation to resist the severe moisture and salt atmosphere conditions ordinarily encountered. The generator bearing is constructed especially to prevent oil leakage due to list of the ship. Metallic parts such as brushholders are made of non-corrosive material.

## MARINE AUXILIARY POWER AND LIGHTING SET



100 Kw. AUXILIARY POWER AND LIGHTING TURBINE-GENERATOR

The great economies and conveniences resulting from electrification of marine apparatus for power and heating, require adequate and reliable auxiliary generating sets in increasing capacity.

The severe conditions imposed by the straining of the vessel and by marine use demand a more rugged and reliable unit than those used for land service.

A 100 kilowatt set has been especially designed to meet these conditions. An unusually heavy bed-plate minimizes misalignment and stresses caused by movement of vessel structure. The turbine is of compact, simple and economical EHNC design.

Besides the usual governor stop and safety stop, heavy restraining rings in the cover and around the hub prevent bursting of casing in case some unusual accident wrecks the rotor.

The oil cooling coil is attached to a flange bolted to the side of gear casing, and is therefore easily accessible.

The generator is impregnated for marine service. The whole unit is unusually rugged, quiet running, economical and reliable.

Besides this unit, these additional lines are offered:  
500-1500 watt headlighter type, direct connected turbines for tug and lighter service.

750-1500 watt gasoline electric power unit, similar to the farm lighting set, but adapted for marine use on yachts, houseboats, tugs and isolated circuits of small power requirements.

The EHNC and the EHC line of geared turbines, especially fitted for marine service. These are available in sizes up to 500 Kilowatts.

Engine generator sets. For operators requiring engine driven generator sets, the B. F. Sturtevant engine, in combination with the Westinghouse generator, as described on the preceding page, is offered.

## MARINE SUPPLY APPARATUS

Marine Supply business represents a field that has not been developed. The numerous electrical devices used on land should also be used on ships, their use being more than justified by their convenience, economy, cleanliness and comfort.

The Westinghouse Company realizes the need of small electrical apparatus on board ship. It is the intention of the company to co-operate with its marine customers so that they may secure apparatus which will meet the exacting conditions of marine service.

Within the past year a special line of Marine fans has been developed which will give more satisfactory service than any other type on the market. These fans are of the desk and bracket type, and may be supplied in the 10, 12 or 16 inch sizes. All of the important parts of these fans are made of brass in order to give maximum marine service. The motor is totally enclosed and special impregnation is provided for the windings. The fans have swivel and hinge joints so that they can be mounted in any position. A special base permits the removal of the fan from wall without removing the screws which hold the base to the wall.

People connected with marine work always demand food prepared in the best possible manner. Food that is baked in Westinghouse baking ovens cannot be improved. The Westinghouse automatic oven controls the temperature required for baking within a very few degrees. This feature means delicious bakery goods that will be uniformly browned and thoroughly baked. The electric oven also has the additional advantages of economy and cleanliness.

It is desirable and in many cases necessary on the modern vessel to provide means of heating liquids, such as oil and water. Westinghouse Bayonet or Strap-on electric heaters provide a very convenient, reliable, safe and efficient means of heating liquids. These heaters are very convenient in that they can be arranged in almost any manner to suit limited space and dimension requirements. By the

operation of a simple switch any desirable amount of heat can be secured. For oil heating, the electric heater has one great advantage over the steam heater in that there is no danger of mixing water with the oil.

Electric air heaters for state rooms are desirable, because of their compactness, and because they eliminate the troublesome steam pipes. There is no danger of frozen steam pipes or obnoxious steam leaks.

A large quantity of porcelain insulators has been purchased by the United States Navy to be used as rigging insulators. These insulators are to be recommended wherever excellent electrical insulation is necessary together with exceptionally great mechanical strength.

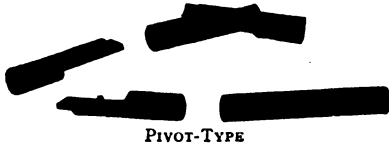
The Westinghouse Company has a line of carbon circuit breakers that meet the exacting requirements of Navy specifications. These breakers are designed for maximum mechanical strength, quick positive action, and are built of the very best materials. In order to place a breaker on the market having the desirable mechanical and electrical features of the Navy type breaker and yet be less expensive, a new line of breakers has been developed which are of great value for the usual marine applications. The latter breakers are finished less elaborately than the Navy type breakers and hence their cost has been decreased without detracting from the essentials which provide for the best service.

The list given below represents some of the electrical articles that can be supplied to marine customers:

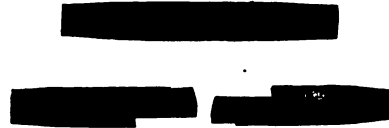
- Fans.
- Heaters.
- Heating appliances of all kinds.
- Baking ovens and ranges.
- Insulation materials of all kinds.
- Switches, fuses.
- Meters.
- Circuit Breakers.
- Switchboards.

# KNUCKLE-JOINT CONNECTORS

## DETACHABLE



PIVOT-TYPE



SEGMENT-PIN-TYPE

Knuckle-joint connectors are used extensively as separable connectors between railway motor leads and the car body wiring in order to facilitate removal of the trucks. They are also often used for connecting wiring between halves of railway motors and in other places where quickly detachable connectors are desirable.

These connectors consist of brass, and are made in two parts, each part being soldered to the respective wire to be connected. After the wires are soldered into the connectors, no tools are required for connecting or disconnecting, since simply straightening out the two halves by hand clamps the parts tightly together and the opposite operation unclamps them. To insulate the joint, it is only necessary to draw a piece of rubber tubing over connector or tape it in the usual manner.

Two types are listed; the pivot-type and the segment-pin-type. One half of the pivot-type has

a central pin engaging with a hole in the other half. Connectors of this type, therefore, require mating. The segment-pin-type has an ingenious arrangement which permits coupling any two halves together, besides which there is an additional interchangeability between connectors of the same diameter. Connectors of this latter type have counterbored holes to receive some of the cable insulation.

Besides the connectors listed in the following tables, connectors can be supplied drilled for different sizes of cable at either end. Special connectors not listed, can be supplied; give full information as to size of cable, drilling of connector and type of connector.

Style number includes connector, consisting of the two halves, complete with drilling as specified.

Style No.	Nominal Capacity in Amperes	Takes Wire or Cable up to B & S Gauge	List Price
<b>Pivot-Type</b>			
47941	25	No. 10	On Request
43105	40	7	
47889	55	3	
43107	80	2	
123692	90	1	
198699	110	00	
138746	80	2	
56354	90	1	
157649	125	000	
11557	125	(Starting Drill)	
11559	150	00	

Style No.	Nominal Capacity in Amperes	Takes Wire or Cable up to B & S Gauge	List Price	
<b>Segment-Pin-Type</b>				
26666	175	000	On Request	
164673	200	0000		
112127	215	250,000		
122659	250	400,000		
159520	300	650,000		
<b>Segment-Pin-Type</b>				
7655	75	No. 2		
35373	100	00		
91383	125	0000		
41595	150	200,000		
99038	200	350,000		

Approximate weight knuckle-joint connector net ¼ pounds, shipping weight 1 pound.

### OUTLINE DIMENSIONS



FIG. 1—PIVOT-TYPE

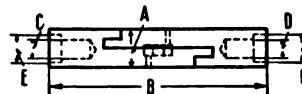


FIG. 2—SEGMENT-PIN-TYPE

Style No.	Fig.	INCHES			Style No.	Fig.	INCHES							
		A	B	C			A	B	C	D	E	F		
47941-A	1	★	2 1/4	1/2	7655-A	2	3/4	5 1/4	1/2	1/2	1/2	1/2	1/2	1/2
43105	1	★	2 1/2	★	35373-A	2	3/4	5 1/4	1/2	1/2	1/2	1/2	1/2	1/2
47889	1	★	2 1/2	★	91383	2	3/4	6 1/4	1/2	1/2	1/2	1/2	1/2	1/2
43107	1	★	3 1/4	★	41595	2	1	6 1/4	1/2	1/2	1/2	1/2	1/2	1/2
123692	1	★	3 1/4	1/2	99038	2	1	7	1/2	1/2	1/2	1/2	1/2	1/2
198699	1	★	3 1/4	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*138746	1	★	4	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*56354	1	★	5	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
157649	1	★	3 1/2	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*11557	1	★	5	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*11559	1	1	5	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
*26666	1	1	5	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
164673	1	1	4H	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
112127	1	1	5	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
122659	1	1 1/2	5 1/4	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
159520	1	1 1/2	6	★	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

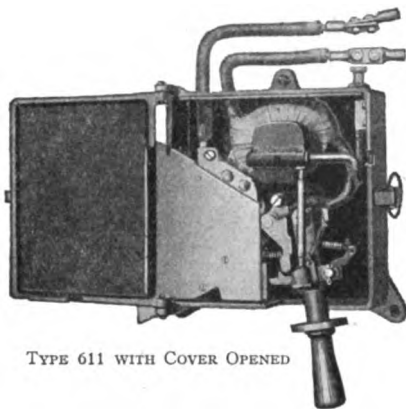
\*Has ends counterbored to receive cable insulation as indicated in Fig. 2.

These dimensions are for reference only. For official dimensions apply to the nearest District Office.

Order by Style Number

## RAILWAY CAR-TYPE CIRCUIT-BREAKERS WITH MAGNETIC BLOWOUT

For Direct-Current 600-Volt Circuits



TYPE 611 WITH COVER OPENED

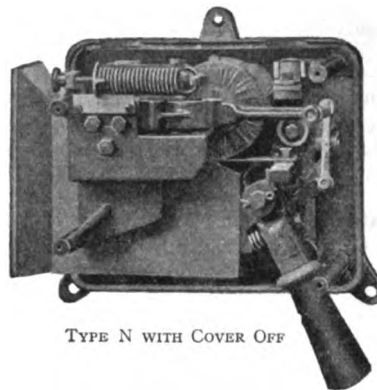
Dimensions:  $11\frac{1}{4} \times 14\frac{3}{8} \times 4\frac{1}{4}$  inches.

**Application**—These circuit-breakers are intended for use on street cars, mining locomotives and for other purposes where an automatic circuit interruptor with magnetic blowout is required.

**Choice of Breaker**—In determining the proper size of breaker to be used, select one where continuous rating as given below is within the continuous current of the service to be performed. For intermittent duty such as on railway cars, approximately 65 to 70 per cent of the total hour rating of the motors is used as a continuous rating. The tripping range is determined by the permissible peaks to be encountered in service.

**Mounting**—Circuit-breakers should always be mounted with the arc chute pointing either up or to the side, but not down if it can be avoided. The case should not be grounded and if baffles are used in front of the arc chute, they should be at least 6 to 10 inches away.

**Construction**—Rugged construction with heavy parts, all of which may easily be inspected, is used in the making of these circuit-breakers. They are designed to take care of the normal overloads encountered in regular service for which such apparatus is intended. They are not designed, however, to handle extreme conditions, such as continuous heavy short circuits. For this purpose we make electro-pneumatically operated line



TYPE N WITH COVER OFF

Dimensions:  $13\frac{3}{4} \times 14\frac{1}{2} \times 8$  inches.

switches, specially designed for these conditions.

**Adjustment**—Thumb screws permit adjustment to increase or decrease the tension of a spring attached to the tripping armature.

### Type 611 Circuit-Breaker

All parts of the Type 611 breaker are enclosed by a cast aluminum case with hinged cover of the same material. All working parts are mounted on an insulating base which in turn is fastened to the inside of the box. Parts may be removed as a unit by taking out the arc chute and removing five screws from the base. All parts of this line of breakers are identical except for the blowout coils which vary for the different capacities. This type of breaker is closed by moving the handle to the left and is tripped either magnetically by overload or by moving the handle to the right.

### Types N and 491 Circuit-Breakers

All working parts of the Type N and Type 491 breakers are mounted on a cast iron base and enclosed with a sheet brass cover. All parts of this line of breaker are identical except for the blowout coils which vary with the capacities of the different units. The breaker is closed by moving the handle to the left, and is opened by overload or by pressing a button on the cover.

### RATINGS

Style number includes railway type circuit-breaker complete, but without mounting bolts.

Continuous Capacity Amperes	Adjustment Range Amperes	Type	EACH		Style No.	List Price Each
			APPROX. WT. Net	LBS. Shipping		
60	110-350	611-A-4	24	34	266321	On Request
90	180-500	611-A-3	24	34	256782	
110	200-600	611-A-2	24	34	256781	
140	250-900	611-A	24	34	256780	
200	200-800	N	40	52	44887	
300	300-1200	491-A	40	52	166956	
400	400-1600	491-A-2	40	52	166956	

NOTE—When choosing a breaker for a specific motor, see that the continuous rating of the breaker is at least 65 per cent of the motor hour-rating. It is standard practice to adjust the breaker to trip at 175 per cent of the total hour-rating.

\*For prices and description of electro-pneumatically operated line switches, apply to nearest District Office.

Order by Style Number

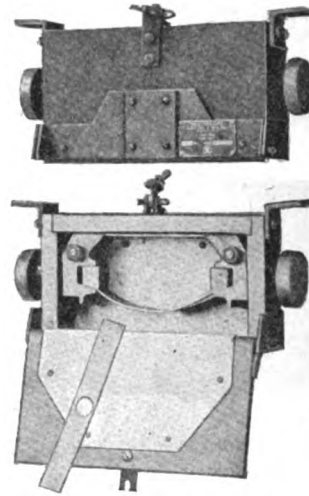
## RAILWAY FUSE BOXES AND FUSES

Fuse boxes as illustrated below are used on railway equipments as ultimate protection to the apparatus. The use of a fuse box does not eliminate the necessity for circuit breakers as the fuse box performs a different function.

**Construction**—These boxes are built up of insulating and arc resisting material and are bound with a sheet steel band which also forms the magnetic blowout for arcs formed when the fuse blows.

**Application**—In railway service fuses are applied on the total hourly rating of the combined motors. Fuses are rated to blow at double the listed value in thirty seconds. These fuses are of the copper ribbon type.

Style number of fuse box does not include fuses.



STYLE NO. 169235

### RATINGS

#### Magnetic Blow-Out Fuse Boxes

Style No.	Continuous Capacity Amperes	Range of Fuses	Application—Total Horsepower Per Equipment at 600 Volts	EACH*	
				Net Weight Lbs.	List Price On Request
169235	250	150-400	100 to 300	11 1/2	
175758	400	500-1000	475 to 720	27	
58653	600	600-1800	.....	30	

### Fuses

**For Box Style No. 169235**

Style No.	APPLICATION		List Price Per 100
	Rating Amperes	Total Rated Horsepower at 600 Volts	
249205	100	60	On Request
249204	125	85	
283009	150	105	
283010	200	140	
81350	250	175	
91351	300	210	
173489	350	250	
171538	400	280	

**For Box Style No. 175758\***

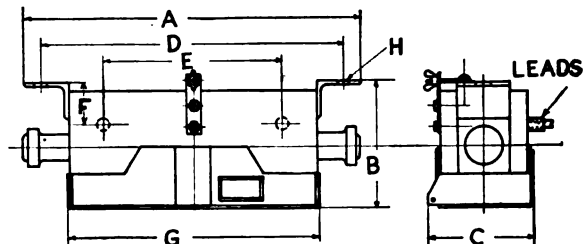
180316	350	250	On Request
180317	400	280	
173861	500	350	On Request
174889	600	420	
175759	750	525	On Request
.....*	1000*	700	
272153	1200	800	On Request
.....*	1500	1000	

**For Box Style No. 58653\***

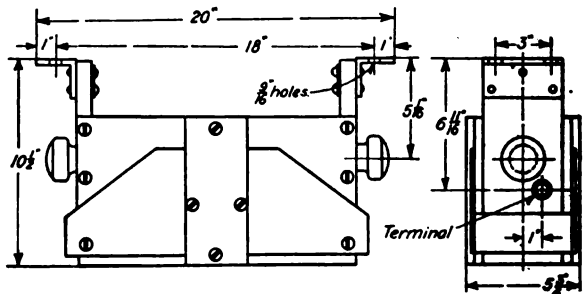
91354	500	350	On Request
91355	600	420	
175521	800	575	On Request
.....*	1000	700	
.....*	1200	800	On Request
.....*	1600	1100	

\*Note—Additional fuse capacities for these boxes are ordinarily obtained by using two suitable fuses in parallel.

### OUTLINE DIMENSIONS†



STYLE NOS. 169235 and 175758



STYLE NO. 58653

Style No.	DIMENSIONS IN INCHES							
	A	B	C	D	E	F	G	H
169235	16	6 1/2	3 1/4	11 1/2	7 1/2	2 1/2	10 1/4	1 1/2
175758	19	7 1/2	5	17 1/2	10	2 3/8	14 1/4	1 1/2

†Dimensions given are for reference only. For official dimensions apply to the nearest district office.

Order by Style Number

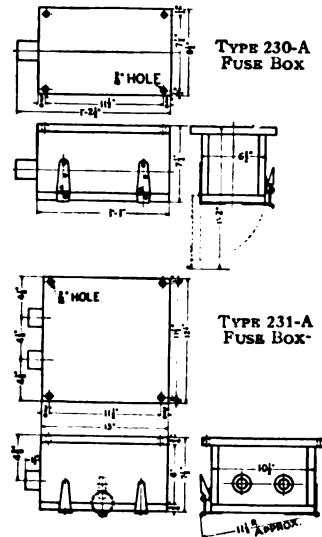
RAILWAY FUSE BOXES AND FUSES—Continued

AUXILIARY CIRCUIT FUSE BOXES

1200 Volts to 3000 Volts

For the fusing of auxiliary circuits employing voltage of from 1200 to 3000, two types of boxes are illustrated. The Type 230-A box is a single pole, and the Type 231-A box is a double pole for separate circuits. These fuses are of the expulsion type depending upon the gas to blow out the arc.

Style number includes fuse box complete with fuse tube or tubes except without fuse wire or asbestos sleeving for the same. For data on aluminum fuse wire see pages on "Fuse Wire, Fuse Ribbon and Link Fuses." About 8 inches length of wire is required for each fuse. Before inserting the fuse wire it should be encased in asbestos sleeving; the asbestos prevents the gradual charring of the fuse tube by an over-heated fuse and thereby lengthens the life and prevents a burning out of the fuse tube or chamber. For asbestos sleeving refer to catalogue section on "Insulating Materials."

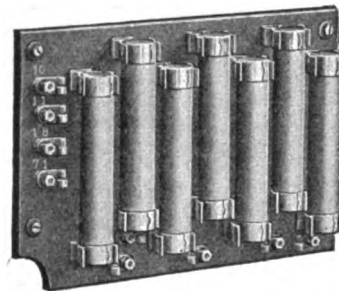


Style No.	Type No.	Features	Capacity Volts	Amperes Continuous	Weight	EACH	List price
200643	230-A	Single Circuit	3000	30	12		On Request
231158	231-A	Two Circuit	3000	30	17 1/4		On Request
165477	.....	Extra Fuse Tube	.....	.....	1 1/2		On Request

\*See price under "Type OD Safety-First Fuse Boxes" in this catalogue.

TYPE D RESISTOR TUBES

Type D Resistor Tubes consist of a strong porcelain tube on which the alloy resistance wire is wound to the proper ohmic value and connected at the ends of the tube to copper ferrules. Before the copper terminals are put in place, the tube and wire are covered with a coating of vitreous enamel. In applying these resistor tubes 10 watts per inch of length should be allowed. As an example: A line voltage 600, current .2 ampere, voltage drop on tube to be 150 volts. The number of tubes required is 150 volts divided by .2 amperes or 750 ohms. 750 ohms with .2 amperes equals 30 watts. One 5 inch tube will take care of this service.



TERMINAL AND RESISTOR BOARD SHOWING USE OF TYPE DE TUBES AND DETAILS

5-Inch Size			6-Inch Size			8-Inch Size			10-Inch Size		
Nominal Cap.—50 Watts*			Nominal Cap.—60 Watts*			Nominal Cap.—80 Watts*			Nominal Cap.—100 Watts*		
Ohms	Style No.	List Price	Ohms	Style No.	List Price	Ohms	Style No.	List Price	Ohms	Style No.	List Price
300	245568		45	277755		80	216708		180	271964	
350	183683		85	212398		200	255851		375	216700	
450	251170	On Request	150	167009		230	216707		400	145388	
550	182085		200	225074		600	152927		500	274872	On Request
700	269982		350	271965		700	241774		700	189853	
1100	285730		400	247490		800	150431		1650	145387	
.....	.....	.....	475	230092	On Request	1050	203090		.....	.....	.....
.....	.....	.....	525	186982		1100	250892	On Request	.....	.....	.....
.....	.....	.....	600	198708		1250	155889		.....	.....	.....
.....	.....	.....	670	167010		1350	249795		.....	.....	.....
.....	.....	.....	800	167008		1500	150432		.....	.....	.....
.....	.....	.....	850	180051		1700	246064		.....	.....	.....
.....	.....	.....	900	226743		2000	166725		.....	.....	.....
.....	.....	.....	1000	287506		2300	282135		.....	.....	.....

\*Nominal Capacity for full ventilation, e. g. when mounted on vertical panel. Use multiplier 8/10 when tubes are enclosed in perforated steel boxes. Use multiplier 5/10 when totally enclosed.

Style No.	Description	List Price per 100
42342	Fuse holder clip only, has drilled hole .203-inch	
229301	Fuse holder clip only, has drilled hole .25-inch	
229302	Fuse holder clip only, has drilled hole .328-inch	
229232	Fuse holder assembly with terminal and fastening for 2-inch panel	
229239	Fuse holder assembly with terminal and fastening for 1 to 1 1/2-inch panel	
47268	Connection clip—L. H. wing	On Request
59355	Connection clip—R. H. wing	
121308	Connection strap, 1/8-inch copper, .201 drilled holes 1 1/2-inch centers	
264203	Connection strap, 1/8-inch copper, .201 drilled holes 2-inch centers	

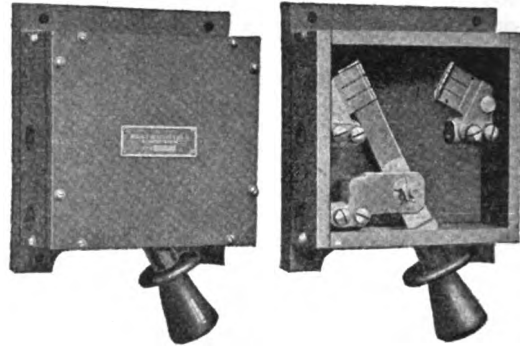
Order by Style Number

## ENCLOSED DISCONNECTING AND INTERRUPTING SWITCHES

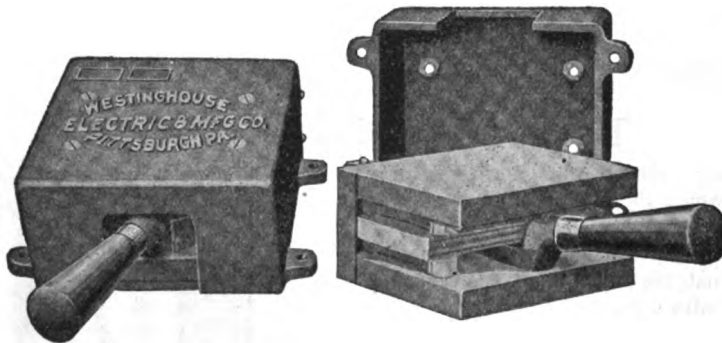
**Application**—The single-pole, single-throw and the single-pole, double-throw disconnecting switches are not equipped with a magnetic blowout, and therefore are not intended for opening circuits carrying current. However, there are various places where remote control is employed and a temporary circuit-opening device is required. The switches listed below may be used for this purpose.

When circuits carrying current are to be opened, switches equipped with magnetic blowout should be used. All single-pole switches are as a rule used on circuits having one side grounded. Double-pole switches are used on both sides of a metallic circuit.

**Construction**—These switches are all of rugged and compact design having ample capacity for the duty to be performed. Some of the switches are enclosed in iron cases, and others in built up boxes of insulating material. Arc resisting material is used on parts adjacent to the arcing jaws.

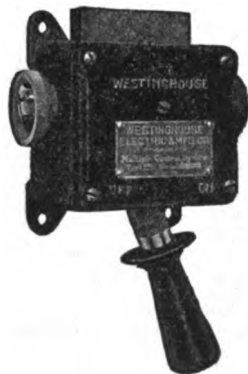


TYPE 492-A—CANOPY SWITCH, DOUBLE-THROW



STYLE NO. 5793-A—CANOPY SWITCH WITHOUT MAGNETIC BLOWOUT

Style No.	Description	Capacity Amperes	EACH	
			Approx. Net Weight, Lbs.	List Price
5793-A	Single-pole, single-throw	150	20	On
5225-A	Single-pole, single-throw	250	20	Request
180281-A	Single-pole, double-throw, Type 492-A	200	13	



TYPE 493-C SWITCH, COMPLETE

Style No.	Type	Description	EACH	
			Capacity Amperes Per Pole	Approx. Net Weight, Lbs.
238692	493-C	Single-pole, single-throw	60	8
288018	503-D	Single-pole, single-throw	100	25
288017	503-C	Single-pole, single-throw	200	25
120961	503-A	Two-pole, single-throw	200	60



TYPE 503 SWITCH, COMPLETE

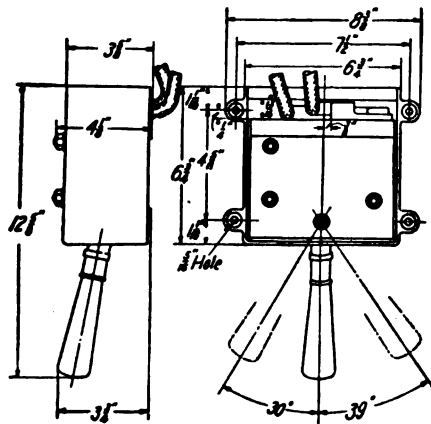
Capacity Amperes Per Pole	EACH	
	Approx. Net Weight, Lbs.	List Price
60	8	
100	25	On
200	25	Request
200	60	

Order by Style Number

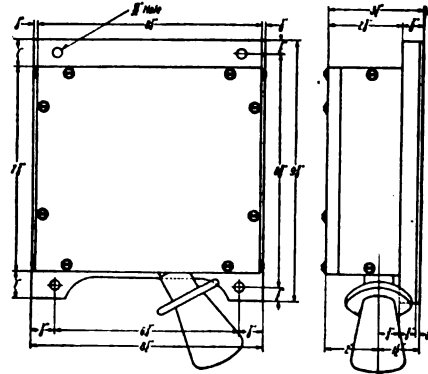


ENCLOSED DISCONNECTING AND INTERRUPTING SWITCHES—Continued

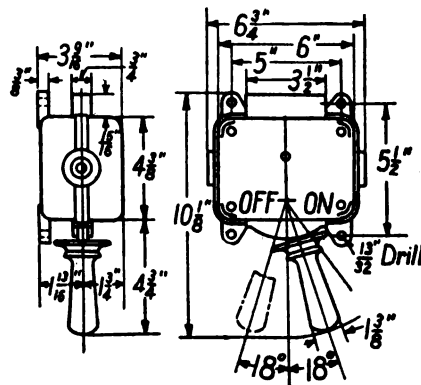
OUTLINE DIMENSIONS



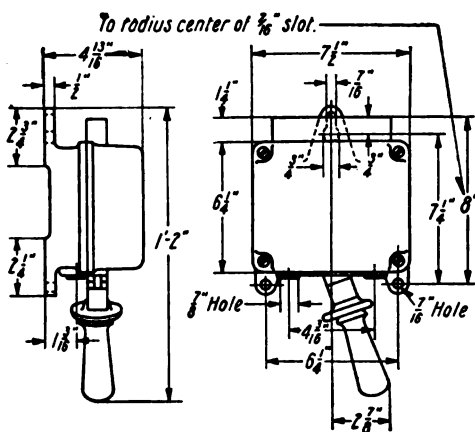
STYLE NOS. 5793-A AND 5225-A



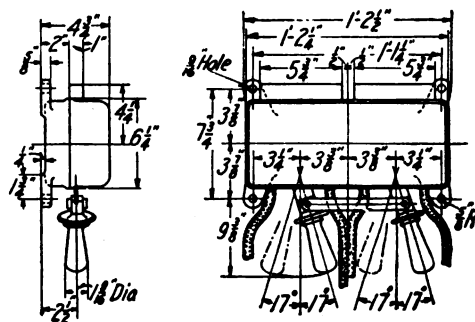
STYLE NO. 180281-A



STYLE NO. 238692



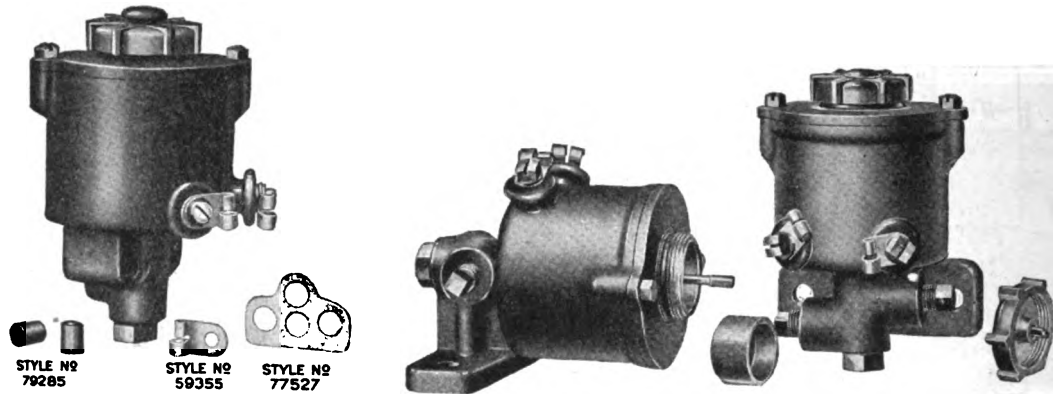
STYLE NOS. 288117 AND 288118



STYLE NO. 120961

These dimensions are for reference only. For official dimensions apply to the nearest district office.

## VALVE-MAGNET RELAYS



For operating auxiliary mechanisms for which electro-pneumatic control is desired, the magnet relays listed below may be used. They are essentially magnetically-operated air valves with magnet coil windings for various voltages, and different sizes of valve parts and form of air connection.

The chief use is in connection with an air cylinder, as for "unlocking" and lowering pantagraph trolleys, third rail shoes and for actuating door opening devices, brake and other air cylinders. Another use of these valves is for controlling the air supply to sanders, small whistles and signals. As the volume of air which can be passed is limited by the ports in the magnet valve, these relays are only suitable for the capacities usually associated with the pneumatic control of auxiliary apparatus.

Most construction details of the valve magnets are the same as in the magnets so successful in Westinghouse unit switch controllers for railway equipments. Similar "iron-clad" cases are used to house the valve parts and magnet coils, the terminals of the latter being brought outside through suitable insulating bushings. The moving cylindrical steel

armature is guided by a brass bushing in the cover of the case, and is effectually prevented from sticking or "freezing." Hard phosphor-bronze valve stems form an exceptionally serviceable valve in conjunction with seats in the removable brass valve bushing. Occasional adjustments to compensate for the gradual valve wear will prolong the life of the apparatus indefinitely.

The type 386 valve-magnet relays are designed for separate mounting and pipe connections. Type 386 form O has the largest size valve ports. The type 756-A relays are designed for fastening by tap bolts to the cylinder cap or cylinder with which this relay is to be used, or to an adapter casting. The bracket or lower part of the valve which contains the holes for tap bolts, also has the air inlet and outlet holes for the valve proper. Gaskets and brass bushings in counterbored holes are used to make air-tight connections as the valve bracket is bolted up to the receiving part.

Style number includes valve-magnet relay complete with coil. Bushings and gasket for the air connections of type 756-A relays are extra.

Style No.	Type No.	Nominal Volts (D-C)	Typical Application	PORT DIAMETERS		Weight Lb.	List Price
				Inlet Drill Inches	Exhaust Drill Inches		
210426	386-D3	20	Sander valves Pantagraph Relay valves	.129	.081	5	On Request
280100	386-D4	20		.129	.152	5	
273637	386-D5	100		.129	.152	5	
292775	386-O	100	6-inch cylinder	.157	.281	5 1/4	
234952	756-A	20	General use on 2 to 3 inch diameter cyla.	.129	.129	4 3/4	
252302	756-A2	14		.129	.129	4 3/4	
269975	756-A3	100		.129	.129	4 3/4	

Details used with type 756-A relays  
 79285 Brass bushing for air connection 1/4-inch long  
 77527 Gasket for packing between relay bracket and supporting apparatus  
 59355 Terminal connection clip—R. H. wing  
 47368 Terminal connection clip—L. H. wing

Special sets of valve-magnet relays can be furnished. Refer inquiries to our nearest District Office for information. The sets illustrated above have been used for control of electric locomotive auxiliaries. Both have common air supply to valves and individual pipe-tap outlets at rear.

Order by Style Number

## INSULATED PIPE COUPLINGS AND MOUNTING BOLTS

Insulation strains and breakdowns are reduced if the switching apparatus and main current carrying parts are insulated from ground, particularly with present day steel car underframes. Insulating details below meet requirements of usual erection layouts.

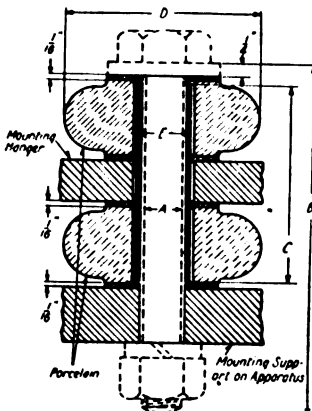
In the insulated pipe couplings the insulation is of high grade material and liberally designed. These joints in actual practice have proven themselves exceptionally strong and durable. They are intended for nominal 600-volt service, but two in series using a close nipple between, may be used on 1200-1500-volt apparatus and will afford ample protection.

Porcelain mounting bolts are recommended especially for hanging grid resistor frames and all apparatus in which there will be no interference with the hangers. They are ordinarily included as

part of 1200-1500-volt control equipments. It will be found convenient to order the details without hardware when it is necessary to cut

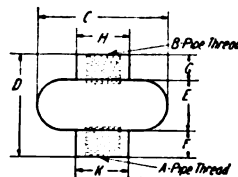
or trim the insulating tube down to the particular bolt length as required and supplied by customer. The moulded composition type of insulated bolt is highly recommended for use with all types of 600-volt apparatus. The insulating washers are made of very satisfactory moulded material, and being of comparatively small diameter may be used in many places to advantage over the porcelain type.

NOTE: Insulating pipe couplings should always be placed in vertical runs of conduit or air pipe and with regard for accessibility to cleaning at inspection or overhauls. Likewise the insulating washers on mounting bolts should be kept clean in order to maintain maximum insulation protection.

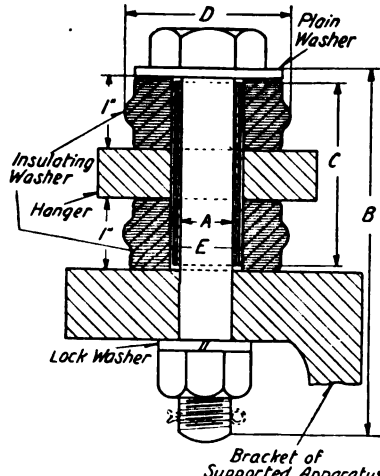


BOLT WITH PORCELAIN INSULATION

part of 1200-1500-volt control equipments. It will be found convenient to order the details without hardware when it is necessary to cut



INSULATED PIPE COUPLING



BOLT WITH MOULDED INSULATION

### INSULATED PIPE COUPLINGS (Insulated Joints)

Style No.	Pipe Size	DIMENSIONS IN INCHES										Weight	List Price	
		A	B	C	D	E	F	G	H	K				
<b>For Air Connections to Control Apparatus—Brass</b>														
147702	1/4	3/4	1 1/4	1 1/2	1 1/2	1 1/2	3/8	3/8	1 1/4	1 1/2	1 1/2	6 oz.	} On Request	
235025	3/8	1	1 1/4	1 1/2	1 1/2	1 1/2	3/8	3/8	1 1/4	1 1/2	11 oz.			
147703	1/2	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	3/8	3/8	1 1/4	1 1/2	1 lb. 2 oz.			
<b>For Conduit Connections to Control Apparatus—Malleable Iron</b>														
147704	3/4	1 1/4	2 1/4	2 1/4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2 lb.	} On Request		
147705	1	1 1/4	2 1/4	2 1/4	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2 lb.			
147706	1 1/4	1 1/4	3 1/4	2 3/4	1 1/2	1 1/2	1 1/2	1 1/2	2	2	1 1/2 lb.			
* (These sizes are special)	1 1/2	1 1/2	4 1/2	2 3/4	1 1/2	1 1/2	1 1/2	1 1/2	2 1/2	2 1/2	.....			
	2	2	5 1/2	3 1/4	1 1/2	1	1 1/2	1 1/2	3	3	.....			

### PORCELAIN MOUNTING INSULATION AND BOLTS

STYLE No.	Insulation and Bolt Complete	Insulation Details Without Hardware	DIMENSIONS IN INCHES					LIST PRICE	
			SIZE OF BOLT	THICKNESS OF HANGER	DIMENSIONS OF INSULATION			Insulation and Bolt Complete	Insulation Details Without Hardware
			A	B	C	D	E		
230239	279252		3/8	4 1/4	5	3	3 1/2	} On Request	} On Request
266634	279252		1/2	4	5	3	3 1/2		
230238	279252		1/2	5	5	3	3 1/2		
230237	279249		3/4	5 1/2	5	3 1/2	1		
230236	279249		3/4	6 1/2	5	3 1/2	1		
256168	279249		3/4	7	5	3 1/2	1		
230235	279248		1	7 1/2	5	4	1 1/2		

### MOULDED WASHER TYPE MOUNTING BOLTS

STYLE No.	Insulation and Bolt Complete	DIMENSIONS IN INCHES					Approx. Weight Pounds	List Price
		SIZE OF BOLT	THICKNESS OF HANGER	DIMENSIONS OF INSULATION				
		A	B	C	D	E		
244256		1/2 x 3 1/4	2 1/4	2 3/4	1 1/2	1 1/2	} On Request	
244255		1/2 x 4 1/2	2 5/8	2 3/4	1 1/2	1 1/2		
275410		3/4 x 4 1/2	2 5/8	2 3/4	1 1/2	1 1/2		
244254		3/4 x 5	2 5/8	2 3/4	1 1/2	1 1/2		
284899		3/4 x 5 1/4	2 5/8	2 3/4	1 1/2	1 1/2		
294583*		1/2 x 5 1/4	2 5/8	2 3/4	1 1/2	1 1/2		
210505		3/4 x 6	3 1/4	2 3/4	1 1/2	1 1/2		

\*Have 1/4-inch cotter pins to retain nut on bolt.

Order by Style Number

## AUTOMOTIVE ELECTRIC EQUIPMENT



AUTOMATIC IGNITION HEAD



NON-AUTOMATIC IGNITION HEAD

Westinghouse Ignition combines simplicity of design with the highest efficiency and dependability.

### Types DA and DN Ignition

The Westinghouse type DA automatic and type DN non-automatic ignition devices are of the wipe contact spark and closed circuit type and are supplied for four, six and eight cylinder engines, and may be supplied for either six or twelve volts.

The **bases**, which are made of an aluminum alloy, are exceedingly light in weight and present a very fine appearance.

The **distributor shaft** is hardened steel ground to size. The shaft turns within bronze bearings pressed into the top and bottom of the distributor shank, which are lubricated from an oil cup on the outside of the distributor.

The **cam**, which is moulded from micarta, is self lubricating and requires no attention whatever and shows an absence of wear after many thousands of miles of car operation.

The **distributor arm** is of the balanced type. It is made of moulded micarta having high di-electric strength and has a brush holder embedded in one end.

The **contacts** are of purified tungsten, accurately ground to face surface, ample in size with assured long life.

The **condenser and coil** are accurately balanced

electrically and a hot spark is secured at all motor speeds; highly successful operation is assured with minimum current consumption and with an absence of sparking at the contact points.

### Types JA and JN Ignition

The construction of the principal parts of the types JA and JN ignition is similar to the DA and DN. This type ignition has been developed to meet the demand of engineers who prefer the jump spark type of a high quality and to permit a lower price than applies to a contact spark type ignition unit. The parts in which these types differ from the DA and DN are described below.

The Westinghouse type JA automatic and type JN non-automatic ignition units are of the jump spark, closed type. They are furnished for four, six and eight cylinder engines with either six or twelve volt current supply sources.

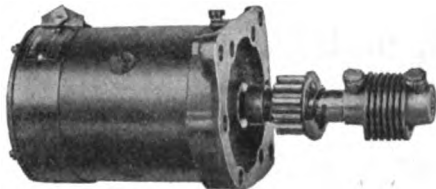
The **distributor arm and contactor** is made of moulded micarta on the top of which is riveted a monel metal distributor arm. There is also securely riveted to the distributor arm, a blue steel contactor spring, the end of which forms a light contact on a graphite ball to complete the circuit—this ball is spun into a brass socket in the center of this distributor cap. Because no contactor brush is required a smaller arm with fewer parts is used.

## AUTOMOTIVE ELECTRIC EQUIPMENT—Continued

**Starting Motors**

The unusually high torque, speed and efficiency of these motors insures a positive starting of the engine while at the same time the demands on the battery are at a minimum.

They are mechanically very sturdy; the brushes and commutator can be readily inspected and the brushes can be replaced without removing the end



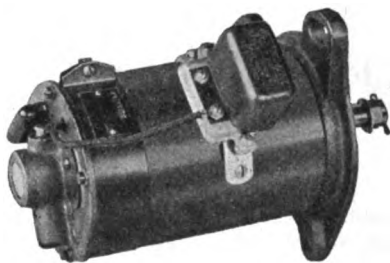
33AB STARTING MOTOR

bracket. Openings in the frame, which are closed by an easily removable cover, give access to the commutator and brushes.

These motors are provided with a magnetic pinion shift and a mechanical screw pinion shift, the latter in either inboard or outboard types. They are designed for single-gear reduction, with a gear ratio of about ten to one for engines up to 1000 cubic inches displacement and can be used at higher ratios for larger engines. Motors are built for both 6 and 12-volt systems.

**Generators**

Generators comprise third brush and voltage regulator types and are sturdily built to stand the hardest service without impairment. A special advantage of the latest Westinghouse generator is that the third brush is arranged so that its position can be adjusted from the outside without taking off the bracket. These generators can be supplied for cradle, flange or foot mounting and usually with either sleeve or ball bearings. Generators are built for both 6 and 12-volt systems.



35AT GENERATOR



BT AMMETER

**Meters**

These instruments are specially designed for use on cars and will retain their accuracy in spite of the severe vibration and occasional heavy overloads to which they are subjected.

The type BT ammeter has no coils nor electrical connections. It is operated by electro-magnetic force. The direction and rate of current flow in the insulated cable which passes through the magnetic yoke from the rear of the instrument, is registered accurately on the dial.

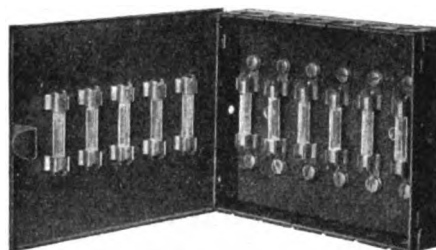
Type BI ammeter has a 2-inch dial, either black or white nickel, as desired. It operates on the polarized-vane principle and has no springs or moving coil.

Type BX ammeter is a 2-inch meter of the highest grade and possesses all the delicacy of action, high sensibility, great accuracy and ruggedness of the standard switchboard type. Supplied for front mounting.

Full details of these meters may be found in Section 3-B of this catalogue.

**Steel Fuse Box**

The steel fuse boxes are compact and are of a rugged and substantial construction, but at the same time, present a neat and pleasing appearance,



STEEL FUSE BOX

enabling them to match in appearance the other equipment with which they may be mounted.

These fuse boxes can be supplied for either 4 or 6 circuits. Inside the cover of each fuse box are holders for carrying extra fuses.

**WESTINGHOUSE ELECTRIC & MANUFACTURING CO.**

**Automotive Equipment Department**

**82 Worthington St., Springfield, Mass.**

# METERS

*For Measuring*

**Water**—Both hot and cold, in large and small volumes.

**Gas**—Both Artificial and Natural in large and small volumes, under high or low pressures.

**Gasoline**—From Service Stations, Tanks, Tank Wagons, Refineries, etc.

**Compressed Air**

**Oxygen**

**Oil**

**Acetylene**

**Hydrogen**

**and Other Fluids**

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**Volume and Pressure Recorders**

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**Gas and Water Meter Provers**

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*Write our nearest Office for  
complete information*

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Chicago, 5 So. Wabash Avenue  
Kansas City, Mutual Building**

**Columbia, S. C., 1433 Main Street  
Seattle, 802 Madison Street  
Los Angeles, Union Bank Building**

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